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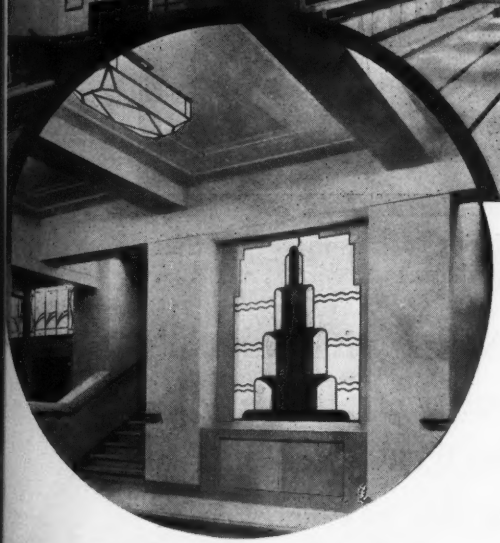

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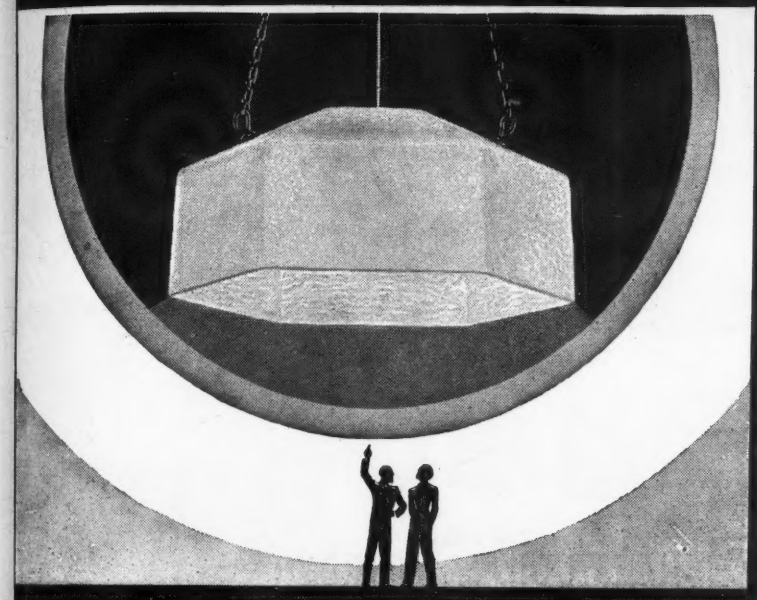

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Official Journal of THE ILLUMINATING ENGINEERING SOCIETY
FOUNDED IN LONDON 1909
INCORPORATED 1930

The ILLUMINATING ENGINEER

THE JOURNAL OF GOOD LIGHTING

Edited by

J. STEWART DOW

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Illumination and Size

TIME and Size are closely related—as a comparison of the universe in space, the solar system, and the contents of the atom reveals.

Size and *Illumination* are likewise associated. If our world contained only large objects, observed at moderate distances and well within the compass of the eye, relatively low illuminations might answer. But as the object becomes more and more minute, the requisite illumination for clear and rapid perception becomes higher and higher—though, be it noted, there may be tasks beyond the powers of the eye whatever the illumination may be!

All this is wonderfully clearly shown in the recent research by Mr. H. C. WESTON, summarised on pages 292-293 in the present number.

This investigation is one of the first fruits of the outstanding paper read by Mr. A. W. BEUTTELL before the Illuminating Engineering Society in 1933. If the other factors determining the illumination requisite for any task can be studied in the same thorough manner this will be a grand piece of work.

The A.P.L.E. Annual Meeting and Conference

Almost immediately after the appearance of this issue the Twelfth Annual Meeting and Conference of the Association of Public Lighting Engineers will have commenced. The programme of papers seems to be a well balanced and interesting one and a number of agreeable social events has been arranged The attendance, we understand, will be far in excess of that at any previous conference. The opportunity of meeting in London has evidently proved extremely attractive to members and delegates from provincial cities, who will have an excellent opportunity of studying the lighting of the metropolis—probably unique amongst cities of the world for the variety of method and lighting equipment on view. The Conference, therefore, should prove an instructive and entertaining one; if so, this will be mainly due to the exceptional trouble which the President and other leading officers and members have taken in connection with the initial preparations. We hope that members and delegates will realise that they, too, have a duty to the Association and will not neglect the opportunity of strengthening its membership

The Illuminating Engineering Society

Special Meeting, September 26, 6.30 for 7 p.m.

There will be a **Special Meeting** on **September 26,** when important proposals affecting the future of the Society will be discussed. *It is hoped that every member will make a special effort to attend.*

Opening Meeting, October 8, 5.30 p.m.

The **Opening Meeting** will be held on **October 8.** The usual Display illustrating developments in illuminating engineering is now being prepared. The Hon. Secretary will welcome offers of exhibits, which should reach him, preferably, by September 20.

Both meetings will take place in the Lecture Hall of the Institution of Mechanical Engineers (Westminster).

The Effect of Lighting on Efficiency in Rough Work (Tile Pressing)

In addition to the very valuable report by Mr. H. C. Weston, summarised on pp. 292-3, the Department of Scientific and Industrial Research and the Medical Research Council have been jointly responsible for another most interesting enquiry, the results of which appear in the report by Mr. S. Adams under the above title.* This report appears opportunely and supplements Mr. Weston's work. The investigation described by Mr. Weston was necessarily a laboratory one, and was concerned with the visual inspection of small objects. Mr. Adams, on the other hand, presents an enquiry made under practical conditions in a factory, and dealing with " tile pressing," a very rough and almost mechanical operation. Even in this case, however, the investigation confirms others in revealing the influence of better lighting on efficiency. An increase from the original low illumination of 0.6 foot-candle to nearly 15 foot-candles leads to continuous improvement in efficiency—though, as might be expected, the improvement is mainly achieved in the initial stages. Thus at 3 foot-candles the increase in efficiency was already 8 per cent.; at 4 foot-candles 9 per cent., and at 14.3 foot-candles (the maximum value) 10½ per cent. increases were recorded—a relatively small further advance. It would seem, therefore, that the research confirms the general belief that in the case of very rough processes the greater part of the benefit derivable from higher illumination has been attained when 3-4 foot-candles is provided. The significant point, however, is that even in the roughest form of work, such as, in common parlance, " can almost be done in the dark," a reasonably good illumination is really necessary. The adoption of such low values as that originally furnished in this case may well result in a loss of output substantially greater in value than the cost of providing good illumination—quite apart from the benefit to the health and spirits of workers that higher values of illumination secure.

* Published by His Majesty's Stationery Office: 4d. net.

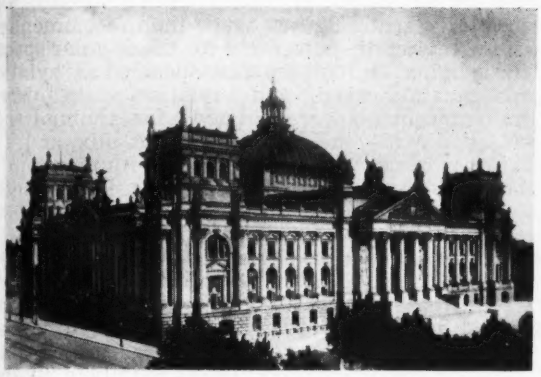
Shipping, Engineering and Machinery Exhibition: Annual Visit.

We are asked to mention that Tuesday, September 24, has been selected for the visit of members of the Illuminating Engineering Society and the Association of Public Lighting Engineers to the above Exhibition —an annual event which invariably proves interesting. Members of both bodies are receiving direct invitations.

International Commission on Illumination

Ninth Session — Berlin—Karlsruhe — July, 1935

In what follows we present, as promised in our last issue, a more detailed summary of the proceedings of the International Commission on Illumination, which will no doubt be published in full by the Central Bureau in due course. It is naturally impracticable to do more than furnish a general survey; but we think that readers will agree that our contributor has discharged very ably this exceedingly difficult task.—Ed.



A view of the Reichstag, where the conferences in Berlin took place.

The "Studenthaus," where the meetings in Karlsruhe were held.

The ninth plenary session of the Commission Internationale de l'Eclairage (C.I.E.) was held in Germany from July 2 to July 10, partly in Berlin and partly in Karlsruhe (Baden). It will be remembered that the last session was held in this country in 1931, and it was then arranged that the session in Germany should take place in 1934. Various considerations showed this to be inexpedient, and the meeting was, therefore, postponed for a year. That this decision was fully justified may be judged from the fact that the number of delegates attending the session just concluded was considerably more than at any preceding session. In all, there were over 300 delegates from countries other than Germany, the names of the countries represented being as follow:—

Austria.	Hungary.
Belgium.	Italy.
Czechoslovakia.	Japan.
France.	Poland.
Germany.	Spain.
Great Britain.	Sweden.
Holland.	Switzerland.
	U.S.A.

The only member-country not represented was the Argentine. Spain was admitted to membership at the opening meeting. The U.S.S.R. sent observers, and has applied formally for membership. If this application is accepted the number of countries adhering to the Commission will be seventeen.

In addition to the three general sessions, there were no fewer than twenty-seven technical meetings on the programme, and as several of these had to be continued at supplementary meetings, the total number of meetings held could not have been far short of forty. It is a tribute to the excellence of the arrangements made by the German National Committee, in collaboration with the Secretariat of the Commission, that such a large number of meetings were held without the slightest disorganisation or mutual interference; on several occasions five meetings were in progress simultaneously.

The accommodation at Berlin was on a magnificent scale. Practically the whole of one floor of the Reichstag building was placed at the Commission's disposal. At Karlsruhe, the meetings were held in the new Students' Institute of the Technische Hochschule, and, although the accommodation was not, of course, as ample as at Berlin, it was always fully adequate.

The British delegation was an exceedingly strong one, consisting of no fewer than fifty-three members; it was, in fact by far the largest visiting delegation present. It was representative of all sections of the lighting industry, as well as Government departments, research establishments, and the professional institutions chiefly interested. At all the meetings Great Britain was well represented by those qualified to speak with first-hand knowledge of the subject under discussion.

On Monday, July 1, the day before the opening of the Commission session, delegates were invited to attend the meetings of the German Illuminating Engineering Society, held in the Berlin Technische Hochschule. At the morning session three papers were read, one by Dr. Kroh, on the psycho-physiological basis which should be appreciated by the lighting engineer as lying at the foundation of his work, one by Dr. Weigel on visual acuity by sodium and mercury light, especially in street lighting, and one by Dr. Arndt on the limit of visibility of light-signals. Of the three papers presented in the afternoon, the one which proved to be most generally interesting was that by Seeger, on the statistics of the electric lighting industry in Europe, with particular reference to its influence on central station loads.* There was no discussion on the papers, which will,

* This paper has been translated into English by Mr. W. J. Jones, and copies were available to English-speaking delegates before the meeting.

presumably, appear in due course in "Das Licht," the official journal of the D.B.T.G.

First Plenary Meeting.

This was held on Tuesday, July 2, at 11 a.m., immediately after a meeting of the Executive Committee. The proceedings were opened by the President, Dr. A. Meyer, who referred briefly to events in the world of illuminating engineering during the past four years. An address of welcome was delivered by Dr. Lippert, the representative of the Government for the City of Berlin. Formal business was transacted, including the admission of a new country (Spain), the presentation of the accounts, and the appointment of an editing committee to draft resolutions in each of the three recognised languages. In the afternoon, three technical meetings were held, dealing respectively with aviation (ground) lighting, photometric test plates, and definitions.

Aviation (Ground) Lighting.

This meeting resolved itself, almost from the start, into two separate sections, each of which held several meetings in addition to the one on Tuesday afternoon. The results of their work were embodied in a large number of recommendations. Some of these dealt with the colorimetric definitions of certain lights, notably "aviation green," "aviation red," and "aviation yellow" (now substituted for the "aviation orange" adopted at Zurich). The limits for these colours were specified on the C.I.E. trichromatic system, and on the hue and saturation system. The minimum requirements considered necessary for the lights to be provided at an airport and along an airway were laid down. A very detailed specification for obstruction lights situated (a) at aerodromes, and (b) along airways was prepared, having regard to the various types of obstructions to be marked. The boundary lights at aerodromes were specified as regards colour, candle-power distribution, distance apart, and arrangement on the ground. The colour, form, and other characteristics of approach lights, landing area floodlights, and landing direction indicators were also specified.

Photometric Test Plates.

A good secretariat report was presented by the Polish National Committee, and this was supplemented by a very long and detailed paper, giving an account of experimental work carried out in Poland. The paper, of which copies were available at the meeting, is published in French in the "Annales de l'Académie des Sciences Techniques," of Warsaw, Vol. 2 (1935), p. 15, and contains curves of brightness variation for a number of materials frequently used as test plates. At the conclusion of the meeting it was decided to recommend that test plates should be examined for selectivity and for possible polarising action, as well as for their diffusing properties. It was also recommended that the departures from the cosine law exhibited by plate (rectifier) photo-cells should be studied.

Definitions and Symbols.

At this meeting it was agreed to recommend the use of the following abbreviations:—

lumen	lm
lux	lx
stilb	sb

The last-named unit is the c.g.s. unit of brightness, viz., one candle per square cm. of projected area. The international definition of luminous flux was amended so as to make it clear that the energy at different wave-lengths was to be weighted in accordance with the C.I.E. table of relative luminosity (visibility) factors. It was agreed to put in hand a complete revision of the photometric definitions.

Wednesday, July 3, was entirely devoted to technical meetings. In the morning the subjects dealt with were aviation (aircraft) lighting, the classification of light distributions, and the photometry of discharge tubes. In the afternoon there were meetings on automobile headlights, factory, and school lighting, and colorimetry.

Aviation (Aircraft) Lighting.

A large number of recommendations were made with regard to the navigation and other lights carried on aircraft. It was felt that the regulations of the Commission Internationale de la Navigation Aerienne (C.I.N.A.) with regard to these lights were not altogether satisfactory, and that a specification based on candle-power, rather than visibility, was desirable. Certain figures were then recommended, both for the candle-power and for the angular spread of these lights. The colours were specified as "aviation red," "aviation green," and "aviation white." Minimum requirements were laid down for landing lights, both as regards their total luminous flux and the maximum beam candle-power. The illumination of aircraft instruments was carefully considered, and a number of recommendations were made, both as regards illumination by lamps mounted on the dashboard (the avoidance of glare is very important in such cases), and as regards the use of luminescent material for the figures and markings. The lights required by the C.I.N.A. in the case of hydroplanes were considered to be very difficult to provide, and alternative proposals were made. Finally, a number of terms were defined, supplementary to those for which definitions have already been adopted.

Classification of Light Distributions.

The scheme of classification originally considered at Cambridge was further amplified, and the following table of classes was adopted:—

Class.	*Characteristics.*
(a) Direct	90% or more flux emitted in lower hemisphere.
(b) Semi-direct	Over 60% and less than 90% in lower hemisphere.
(c) Mixed, or general	From 40% to 60% in each hemisphere.
(d) Semi-indirect	More than 60% and less than 90% in upper hemisphere.
(e) Indirect	90% or more in the upper hemisphere.

Photometry of Luminous Discharge Tubes.

The report of the Secretariat Committee (Hungary) gave a very complete résumé of work on this subject, most of it carried out in Great Britain. The trichromatic method of heterochromatic photometry had been studied in Hungary, and some discussion took place on the practicability of this method as applied to the photometry of luminous discharge tubes. No very definite conclusions were reached.

Automobile Headlights.

The recommendations made at Cambridge were somewhat amplified and modified in certain respects It was recommended that the driving light should be capable of producing an illumination of at least 0.1 ft.-candle on a vertical surface 100 metres ahead, for a height of 1 metre, and a breadth of 4.25 metres on either side of the centre line of the car. The lack of advantage of a coloured headlight beam for use in fog was confirmed. For the future the work of the

committee dealing with this subject is to be extended to embrace all lights carried on a car, exclusive of those used for interior illumination.

Factory and School Lighting.

The following revised table was adopted for minimum illumination figures in schools, higher values being recommended to secure comfort and preservation of eyesight:—

Type of Location.	*Minimum Foot-Candles.*
A. Sewing and drafting rooms and rooms for fine work (on the work)...	10
B. Classrooms, libraries, etc. (on the desks and blackboards), laboratories, gymnasiums, etc.	8
C. Assembly rooms and the like	3
D. Dormitories, corridors, etc.	2

Colorimetry.

This subject had been so very thoroughly dealt with at Cambridge that there remained little to be done in the way of formal recommendation. It was, however, decided that, when the hue and saturation method of colour specification was employed, the white used should be the equi-energy white adopted in 1931 as the centroid of the colour triangle.

The morning of Thursday, July 4, was also devoted to technical meetings, the subjects discussed being street-lighting, photometric accuracy, and ultra-violet light.

Street Lighting.

This meeting, as would be expected, attracted a large number of delegates, and a most valuable discussion took place. This was mainly confined to an exchange of views and of experience in the various countries represented. The importance of the brightness of the background against which objects are seen by silhouette on the roadway, was stressed by a number of delegates, and reference was made to the researches now in progress in several countries, notably France and Great Britain, on the reflection characteristics of used road surfaces.

Photometric Accuracy.

There was not much to record on this subject, and future work under this heading will be co-ordinated by the two general committees dealing respectively with visual and with physical photometry.

Ultra-violet Light.

A long discussion took place on the recommendation, contained in the secretariat report and strongly supported by Great Britain, that our knowledge of the subject was not yet sufficiently advanced to make it possible to recommend a system of quantitative measurement based on erythema or any other physiological action. This point of view was finally accepted. It was decided, further, that the Commission should draw attention to the danger likely to arise from the use by the general public of radiation containing any appreciable quantity of energy in wave-lengths shorter than 2,800 Ångstroms.

Lecture on the "Mechanism of Light."

On the afternoon of Thursday, July 4, the delegates had the pleasure of listening to Dr. R. W. Pohl, of Göttingen, who gave a most absorbing lecture on "The Mechanism of Light." The faultlessness of the delivery, and the aptness and smoothness of working of the experimental illustrations left nothing to be desired. Regarded solely as a work of art, the lecture was perfect, and the subject-matter was presented in such a way that it could not fail to hold the attention of any audience. From a consideration of solid incandescence (as exemplified in the candle-flame) the lecturer passed to a brief description of liquid incandescence, and so to the incandescence of gases by electric discharge. In the second part of his lecture, Dr. Pohl described the phenomena of luminescence and fluorescence. Excellent summaries of the lecture were given in French and English by Dr. Halbertsma.

On Friday, July 5, there were further technical meetings both morning and afternoon. In the morning the subjects dealt with were lighting practice, signal glasses, and voltage variations. In the afternoon meetings were held to discuss mine lighting, architectural lighting, and traffic control signals.

Lighting Practice and Lighting Applications.

At this meeting a very useful discussion took place, and it was decided to recommend that during the next three years the Commission should make a special study of the subject of railway lighting, including the lighting of stations, booking-halls, shunting yards, signal cabins, docks, and railway carriages.

Signal Glasses.

This meeting made definite recommendations for the colour limits (expressed on the C.I.E. trichromatic system) to be adopted for coloured glasses for railway signals. These limits include the colours already adopted in this country. It was felt that the work done in 1928, 1931, and 1935 covered the ground sufficiently completely, so that the subject might be regarded by the Commission as closed, at any rate for the present.

Voltage Variations.

There was no secretariat report on this subject, and therefore the discussion did not prove to be of much value. Possibly more progress will be made before the 1938 meeting.

Mine Lighting.

The secretariat report on this subject was prepared by Great Britain, and provided a very valuable summary of the present position in the various countries. The number of experts having first-hand knowledge of the subject is necessarily small, and the meeting was not able to arrive at any concrete recommendations. There is no doubt, however, that a useful start was made, and that during the next few years the subject will receive careful study on the part of illuminating engineers, in co-operation with the engineering staffs of the mines. Some most useful recommendations should emerge from this co-operation.

Architectural Lighting.

This subject does not readily lend itself to concrete recommendations, and the meeting, therefore, wisely recommended that the secretariat committee for this subject should collect photographs of outstanding examples of successful installations, and should arrange for these to be accompanied by technical details of the installations.

Traffic Control Signals.

A considerable number of recommendations were made by this meeting. A diameter of 8 in. (20 cm.) was adopted as standard, and limits were laid down for the transmittance and for the colour (expressed on the C.I.E. trichromatic system) of the red, green, and amber lights. A large number of terms were

defined, most of them substantially as in the British Standard Specification for Road Traffic Control Signals.

Departure for Karlsruhe.

On Saturday, July 6, all the delegates were conveyed in a special train from Berlin to Karlsruhe, a stop being made at Heidelberg for a two-hour trip to the Castle and to see the new open-air theatre, capable of accommodating twenty thousand people. It is perhaps here that mention should be made of the excursions, both technical and general in interest, which were provided for the delegates at Berlin and again at Karlsruhe. Needless to say, there were several social functions, including a concert at the Schoss Monbijou (near Berlin) and a performance of the opera "Arabella" by R. Strauss in the Karlsruhe opera house. These, and the wonderful excursion on Sunday through the Black Forest scenery, ending with a visit to illuminated Baden-Baden, are dealt with elsewhere and this article must be confined to purely technical matters.

On Monday, July 8, there were three technical meetings in the morning (on glare, daylight and vocabulary) and two in the afternoon (on diffusing materials and on units and standards).

Glare.

This subject is one of extreme difficulty and a considerable part of the secretariat report, prepared by Great Britain, was devoted to a scheme for the classification of glare phenomena according to (i.) the type of effect produced (e.g. sensation of discomfort, after-image effects, etc.), (ii.) the type of brightness distribution producing the effect (e.g. working area darker than surround, rapid flicker, abrupt change in brightness level, etc.) and (iii.) the evidence for the effect (e.g. casual observation, direct laboratory measurements, statistics of accident rate, etc.). Such a classification is a necessary preliminary to co-ordinated work by those engaged in research in the different countries, and it was agreed that the scheme suggested might be used as a basis for the future.

Daylight.

The study of this subject was discontinued temporarily after the Cambridge meetings, but at Karlsruhe it was decided to ask National Committees to recommence work, particularly on the relation between the natural lighting of town buildings and their situation relative to surrounding buildings. It was also recommended that investigations should be undertaken, having for their object the establishment of a code of minimum daylight factors required for various classes of work.

Vocabulary.

It was agreed to publish the three-language vocabulary prepared at Zurich, after certain minor amendments and corrections had been made, and to add sections in the Italian and Spanish languages in due course.

Diffusing Materials.

At this meeting two very practical decisions were arrived at regarding the specification of opal glass intended for use in lighting fittings. It was recommended that (a) the overall efficiency of a complete sphere of the glass should be given, the thickness of the sphere wall being at least that necessary to prevent the luminous source from being visible and in no case less than 1.3 mm., (b) the diffusing power of a flat specimen of the glass should be defined as the ratio x/y where x is the mean of the figure of brightness measured at 20° and at 70° from the normal and y is the brightness at 5° from the normal, the specimen being illuminated normally.

Light Units and the Primary Standard of Light.

These subjects were in the charge of a special committee set up at Cambridge and composed mainly of representatives of the various national standardising laboratories. The form of primary standard being studied is the black-body (total radiator) at the temperature of solidification of platinum. Values of the brightness of this standard, reported by the various national laboratories, were in agreement within about one-half of one per cent. The committee reported that it was in close touch with the Comité International des Poids et Mesures, and that this latter body was establishing an advisory committee on photometry the membership of which would be very nearly the same as that of the C.I.E. committee. Arrangements for a fresh international comparison of standards at the temperature of tungsten filament vacuum lamps were reported.

Second Plenary Meeting.

On the morning of July 9 a plenary meeting was held to discuss various matters connected with the organisation and future work of the Commission. It was decided that the Central Bureau should prepare a brochure summarising all the principal decisions which the Commission had taken since its inception and giving a very brief résumé of the work which had led up to these decisions. It was further agreed that an invitation from the Dutch National Committee to hold the next meeting in Holland should be accepted.

The list of subjects to be specially studied during the next three years and the countries to be entrusted with the secretariat duties for these various subjects was approved as follows:—

Subject.	*Secretariat.*
Vocabulary.	Switzerland.
Definitions and Symbols.	France.
Units and Standards of Light.	Central Bureau.
Glare.	Great Britain.
Photometry (Visual).	Hungary.
Photometry (Physical).	Poland.
Diffusing Materials.	Czechoslovakia.
Street Lighting.	Great Britain.
Automobile Lights.	Belgium.
Applied Lighting.	U.S.A.
Architectural Lighting.	Spain.
Aviation (Ground) Lighting.	Holland.
Aviation (Aircraft) Lighting.	France.
Traffic Signals.	Sweden.
Shadows.	Austria.
Mine Lighting.	Germany.
Ultra-violet Light.	Holland.
Lighting Education.	U.S.A.
Voltage Fluctuations.	Italy.
Light Sources.	Germany.

It was announced that, at a meeting of the heads of delegations, the proposal had been made that representatives of national committees, one from each country belonging to the Commission, should meet at some central place about a year or eighteen months before each plenary session. The programme for the session could then be arranged in outline and the progress made in each subject could be reviewed so as to ensure that matters were proceeding satisfactorily. This suggestion met with very cordial approval from the delegates present and the central bureau was instructed to make the necessary arrangements for carrying it into effect.

The only technical meetings held on the afternoon of July 9 were those necessary to clear up points out-

standing from some of the previous meetings. On Wednesday morning, July 10, there were three meetings dealing respectively with lighting education, shadows and physical photometry.

LIGHTING EDUCATION.

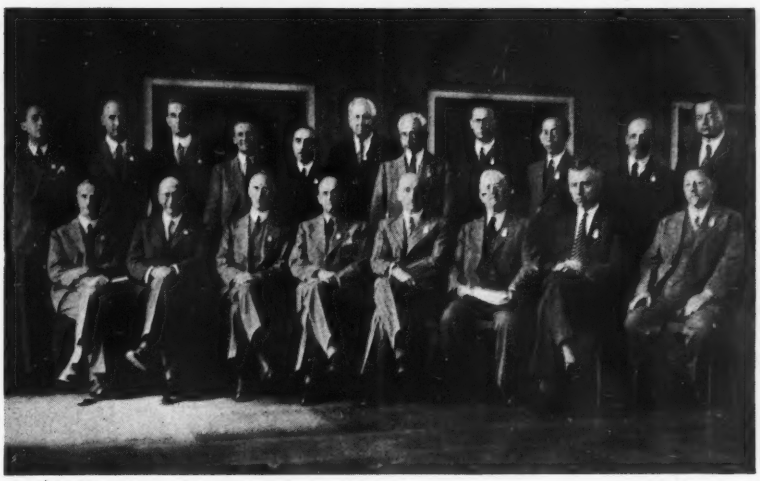
There was little to discuss on this subject. The progress made in the various countries was compared, and it was agreed that further work along similar lines was desirable for the future.

SHADOWS.

This meeting decided that the subject of study should be enlarged to include spatial illumination. (For an explanation of what is meant by this term see the paper by Dr. Arndt in "Congress Proceedings," 1931, Vol. I., p. 197.) It was also agreed to express the directional component in a lighting installation by means of the "shadow-factor." A list of terms employed in the subject is to be prepared.

PHYSICAL PHOTOMETRY.

After the presentation of the secretariat report, the discussion centred mainly on nomenclature. There was a considerable measure of agreement as regards the names to be adopted for the resistance (selenium cell) type, and for the emission (glass-bulb) type, but for the dry-plate type, generally known in this country as the rectifier photocell, it was definitely decided to discourage the use of the terms "blocking - layer" and "rectifier," and to recommend instead the name "photo - e. m. f." (French: photo-pile; German: Photo-element.)



HEADS OF DELEGATIONS AND OFFICERS OF THE COMMISSION.

Standing (left to right):—
J. Urbanek *(Hungary)*; L. V. Rihánek *(Czechoslovakia)*; J. W. T. Walsh *(Great Britain)*; H. Ruzicka *(Austria)*; J. A. de Artigas *(Spain)*; G. H. Stickney *(United States)*; S. Danesi *(Italy)*; C. Zwikker *(Holland)*; Y. Tada *(Japan)*; T. Czaplicki *(Poland)*; L. Schneider *(Germany)*.

Seated (left to right):—
T. Lousberg *(Belgium)*; A. Filliol *(Switzerland)* *(Hon. Treas.)*; C. C. Paterson *(Hon. Sec.)*; A. Meyer *(President)*; G. Ribaud *(France)*; C. H. Sharp *(Vice-President)*; N. A. Halbertsma *(Vice-President)*; H. E. Henke *(Sweden)*.

Final Plenary Meeting.

This was held on the afternoon of Wednesday, July 10. The principal business was, of course, the formal passing, in French, of the various resolutions approved by the sectional committees and summarised in the foregoing sections of this article. In addition, there was the routine business of approving the budget for the ensuing three years and of electing the officers. It was unanimously agreed to invite Professor Ch. Fabry, of France, to become the new President.* The two vice-presidencies vacant were filled by the unanimous election of Messrs. L. V. Rihánek (Czechoslovakia) and O. de Bast (Belgium). The continuing vice-president is Dr. N. A. Halbertsma. The hon. secretary, Mr. C. C. Paterson, and the hon. treasurer, M. A. Filliol, were unanimously re-elected. Votes of thanks to them, to the retiring officers, to Mr. J. S. Preston, the General Secretary, and his staff, and to the German National Committee, concluded the business of the Ninth Session of the Commission.

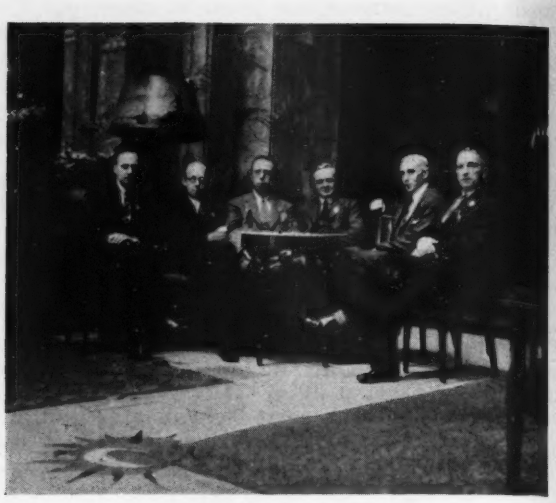
The proceedings will, presumably, be published by the Central Bureau in due course. There is an inevitable delay on account of the fact that, according to the statutes, four months must be allowed for any country to reverse the vote given in its name at the plenary meeting. In any case, the preparation of the official minutes of so many meetings must take no inconsiderable time. The greater part of the volume will, of course, consist of the various secretariat reports. Most of these form excellent summaries of the progress made during the past four years in the various branches of photometry and illuminating engineering, and they give an account of the present state of knowledge of the subject which cannot, usually, be found elsewhere. For this reason alone the "Proceedings" must be regarded as indispensable by every lighting engineer.

The Future.

The next meeting is to be held in Holland in 1938. The criticism has been made that for certain subjects a three-year interval is too long. Aviation lighting is a case in point. This subject is moving so rapidly that what is decided to-day may well be out of date in less than three years' time. On the other hand, for certain of the more stable subjects, particularly those dealing with the methods of photometric measurement, it is improbable that three years will see sufficient change or development to justify a complete secretariat report and a full technical meeting. It is probable that the new proposal to have a meeting of representatives one from each national committee, about midway between the full sessions of the Commission will help to overcome these difficulties. At this small meeting the programme of the following session can be so arranged that most of the time is devoted to the more active subjects, while others, in which progress is less rapid, can either be allotted a short meeting, or can be omitted from the programme altogether for the time being. If this procedure is followed, it may be possible for the Commission to return to the plan of having individual technical papers presented for discussion, but it is, perhaps, too early yet to prophesy what may be found practicable. The work and membership of the C.I.E. have grown so rapidly that each session has necessarily followed rather different lines from those which have guided the previous session. It is a tribute to the elasticity of the Commission's constitution that such development should have been possible without disorganisation, and it may, therefore, be confidently anticipated that the C.I.E. will find no difficulty in continuing to expand and to fulfil its essential rôle in the promotion of good lighting throughout the world.

* It has since been announced that Prof. Fabry has accepted office.

Some Impressions of the I.C.I. Conference in Germany



A group of delegates in one of the hotels in Berlin.

An account is given elsewhere* of the actual work accomplished at the thirty or more meetings which took place in connection with the above Conference. The writer has been asked to give a supplementary account of the trip in somewhat lighter vein.

These notes, therefore, will deal mainly with social events or interesting things seen en route, but readers of both contributions will not fail to gather the correct impression that much hard and serious work, as well as entertaining experiences, figured in the programme!

Officially, this Ninth Session of the Commission opened in Berlin on Tuesday, July 2. But where several people with common interests assemble, discussion soon arises. (At all Conferences the exchange of views "out of hours" is often quite as valuable as that of the formal discussions in sessions.) As the train passed through the busy but somewhat uninteresting industrial areas between Cologne and Berlin, small groups in the various compartments were already in process of formation, and the work of the Conference was already being actively discussed.

Arrival in Berlin.

When visitors had ultimately reached Berlin in the evening and had received their badges and copies of the excellent, carefully prepared itinerary, there was little time to spare before the first item—the dinner given by the German Illuminating Engineering Society (DLTG), when those who had last met at the 1931 Session in England renewed acquaintance and exchanged greetings.

The following day, Monday, was given up to the presentation of six papers (also under the auspices of the DLTG) in the Lecture Theatre of the Physical Department of the magnificent Technische Hochschule.

The papers dealt with a variety of subjects:—

The Anthopological Basis of Illuminating Engineering. (Prof. Kroh.)

Visibility in Sodium and Mercury Lighting; with special reference to Street Lighting. (Prof. Weigel.)

The Limit of Visibility of Light Sources. (Dr. Arndt.)

The Satisfaction of Lighting Requirements as an Economic Factor. (Dr. Adolph.)

The Importance and Development of Electric Illumination in Europe from the Power point of view. (Herr Seeger.)

The Status of Street Lighting by Gas and its Influence on the Economics of Gas Works. (Ing. Müller.)

A special experimental lecture on the Mechanism of Light Emission was also delivered by Professor Pohl of Gottingen. The papers were followed with keen attention and enthusiasm, and the design of the Lecture Theatre, in which they were presented, also aroused interest. There is seating accommodation in long rising tiers, for nearly one thousand students. The seats and desks are of wood finished in grey cellulose and built up on a structure of chromium-plated steel tubing. Each tip-up seat is provided with a separate writing desk which may be converted into a book-rest. The lighting, which was brilliant and yet restful, was effected by concentrating mirror glass units placed above openings in the ceiling. Certain of the circular openings provided ventilation. The lecturer was separately "floodlighted" from concealed units, also mounted in the ceiling, and the whole installation was controlled by dimmers. Opaque black blinds, electrically operated, served to darken the room.

On Tuesday came the official opening ceremony, held under the presidency of Dr. Meier, with impressive dignity in the large meeting room of the Reichstag, which had been courteously placed at the disposal of the I.C.I. Dr. Lippert, State Commissioner for the City of Berlin, welcomed the delegates on behalf of the German Government. During the next three days the Reichstag building, with its cool corridors and dignified assembly rooms, was enlivened by the presence of delegates from some fifteen different nations. The official languages of the meetings were French, English, and German. In most cases the meeting was fortunate in having a Chairman who could speak all three tongues with fluency.

Informal Discussion.

It was, however, interesting to observe how English gradually became the predominant language of so many of the meetings. We wondered if this was because the English delegates had so much to say, or was it a mark of courteous consideration on the part of the other delegates, who included many linguists in their number?

A chairman's task is usually an arduous and not always an enviable one. To preside over such an assembly of nationalities, as this calls for exceptional gifts. In the circumstances the various chairmen acquitted themselves well. To be present at a meeting at which Dr. Halbertsma presides is always a joy! His remarkable knowledge of languages, sense of humour, and genial manner, guides the most difficult meeting, until everyone is pleased and every point is covered. Although much was done, the agreeable air of informality which pervaded the meetings rather came as a surprise to a newcomer inclined to associate such meetings with rather tedious formality.

* See pp. 283-7 in this issue.

Outside the Railway Station at Karlsruhe, where illuminated letters "I.C.I." greeted the delegates.

Floodlighting in the Castle Gardens, Karlsruhe.

A group of delegates (Mr. G. T. Winch, Mr. J. M. Waldram, Mr. G. H. Wilson and Mr. T. E. Ritchie) outside the Studenthaus, Karlsruhe.

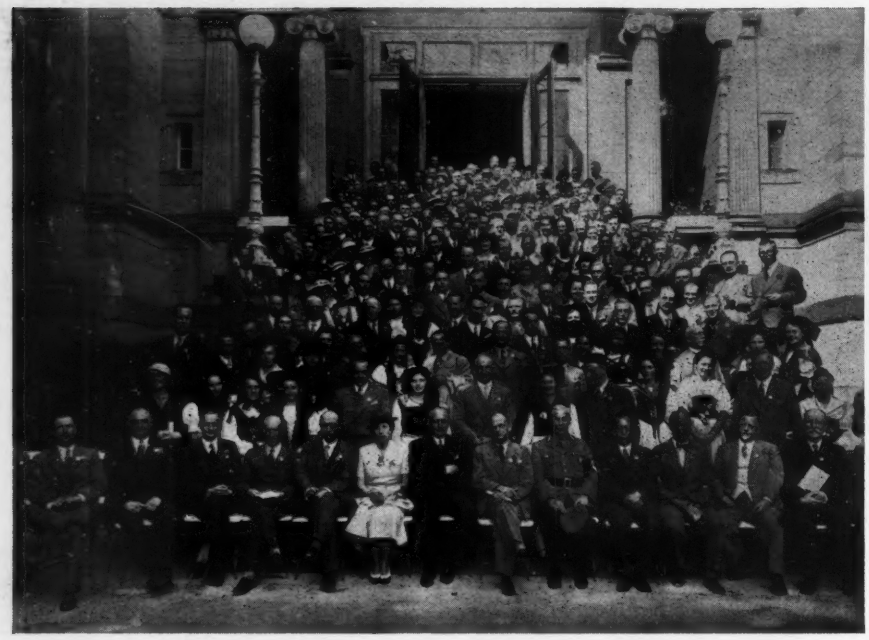
Dr. Halbertsma, who presided so skilfully at many meetings, leaving the I.C.I. building.

Other delegates (Mr. F. C. Smith and Dr. S. English) strolling in the Gardens at Karlsruhe.

A pleasing scene in the Black Forest.

Oxen in harness, still a familiar sight in Southern Germany.

Some Glimpses at the I.C.I. Conference in Germany



A striking group photograph taken after the Mayoral Luncheon in the Festhalle in Karlsruhe—served by girls dressed in their native village garb, in a most delightful setting. Some of these girls in national costume can be seen in the photograph dispersed amongst the delegates.

The desire to exchange ideas and to reach useful conclusions was always evident.

Life during this period became somewhat hectic. All those meetings which one particularly wanted most to attend seemed to follow in succession!

Commencing at 9.30 a.m. and 2.30 p.m. (and promptly, too), there was little time to accept the many kind invitations showered on us to visit the works, etc., around Berlin.

In all the buildings that we visited the most up-to-date equipment and methods were found. In one factory a high-intensity spot light was focussed on to the die of large presses whilst the surrounding level of illumination was kept very low.

This, we were somewhat surprised to learn, was the method approved by the workers, and it was stated that headaches and strain had been greatly reduced since its introduction.

Excursions and Experiences.

The short luncheon intervals provided the opportunity for many unofficial international conferences, and probably the Krollgarten Restaurant heard more about lux or foot-candles than it has for many a year.

The British Building at the Brussels Exhibition. A striking example of concealed lighting, with the luminous "fan" opening and shutting above, designed by Mr. Howard Robertson.

Yet those responsible for the arrangements had evidently recognised that too many lumens may make even an I.C.I. delegate a little dull, and attractive interludes were provided.

The excursion to Potsdam will linger in the minds of many. That ancient and unspoiled town has a fascination of its own. We wandered through the beautifully kept gardens of the old palaces, magnificent in design, but only memories of their former pomp. Then to Berlin's playground, the Wannsee, by boat along the lovely river Spree, and back to Berlin by coach. There were other delightful experiences, such as the evening with Mozart and Bach in the ancient candle-lit Hall of the Schloss Monbijou, and the Banquet at the Hotel Esplanade where, on the screen, we saw ourselves as the movie-camera saw us, enlivened by a humorous commentary by Dr. Halbertsma.

Street Lighting in Berlin.

The evening drive round Berlin also gave us a glimpse of German methods of handling street lighting. Two installations deserve special notice. First the lighting, by sodium electric discharge lamps, of the Hamburg Road. The 70-watt lamps, in simple rectangular vitreous enamelled reflectors, are mounted about 35 feet high and spaced only 20 metres apart, an ingenious suspension device being adopted to avoid the use of a prohibitive number of columns.

The result is excellent lighting with an apparently low illumination and surface brightness, but the ease with which distant objects could be detected was remarkable, largely due, no doubt, to the absence of glare.

The second installation comprised 425-watt mercury discharge tubes mounted about 25 feet high, but with a closer spacing than is usual in this country.

The lamps were in pairs on either side of a wide thoroughfare. The units themselves were extremely simple; consisting of a metal top

Another striking example of spectacular lighting, cylindrical building with luminous walls.

carrying a white opal cylinder some fifteen or sixteen inches in diameter which extended well below the tube. This type of unit, used in conjunction with the standard gas-filled lamp is commonly employed in Germany.

The result, apart from the colour, was most pleasing. The illumination in this case was brilliant and the absence of glare again a feature.

It was observed that many of the high pressure gas lamps were fitted with a deep conical globe which replaced the familiar pear-shaped fittings. The lower portion of the globe was opal, whilst the upper part was clear glass, so that towards the mid span the light was unobstructed, giving an improved appearance to the fitting and diminishing the diversity factor of the installation.

The use of pressure wave controllers for lighting and extinguishing gas lamps seemed popular in Berlin where, it was understood, about 80 per cent. of the street lighting is still done with gas.

A novel two-colour device in Berlin took the form of an assembly of red neon and mercury blue tubes, apparently twisted together, giving a very striking effect.

After nearly a week in Berlin the entire Commission left for Karlsruhe on July 6. A special train conveyed the delegates and a stop was made at the beautiful city of Heidelberg, where a hasty tour of the old castle, the town and the new open air theatre afforded a glimpse of this romantic spot.

Welcome to Karlsruhe.

On arrival at Karlsruhe we were faced at the station entrance by an erection of flowers and leaves carrying the letters S.B.K. in luminous tubing, with the corresponding English initials (I.C.I.) and the French (C.I.E.) on either side, whilst above blazed gas torches. The procession round the town revealed many examples of artistic floodlighting effects. Hotels and houses had contributed to the display by lining their windows with hundreds of red fairy lights, and the scene in the main square was an unexpected and entrancing one.

Amongst a series of days enlivened by new experiences and full of interest Sunday, July 7, would doubtless be selected by many as likely to linger longest in the memory. The day opened at 10 a.m. with the mayoral reception in the beautifully decorated Town Hall, where delegates received a warm welcome to the capital of Baden. This was followed by music, terminating with the singing of German national melodies and a drive round the town brought the party to the Stadtgarten Restaurant, where the delegates were entertained to luncheon by the Mayor. Masses of roses decorated the table. A rose was placed on each menu for the guest's buttonhole. A "Jester," in full regalia, read the welcome, and then came a pleasing surprise. As the lights were dimmed a procession of girls in national costumes brought in lighted candlesticks and placed them on the table, then returning with the wine.

Then once again we joined the waiting coaches for a drive through the Black Forest. When, after passing through the romantic scenery of the Forest, the coaches reached Baden-Baden thousands of fairy lights renewed the welcome. Here, again, the Mayor with great kindness received the delegates and in the Kurhaus dined with his guests.

Early on Monday morning we returned to Karlsruhe only to find gifts—"to the honoured guests" from the town awaited each delegate in his bedroom.

Such is German hospitality!

For the next three days the meetings were held in the new student house—a building of many unique architectural features. In the entrance was placed the original spherical integrator designed by Ulbricht of Dresden.

An interesting afternoon was spent visiting the photometric laboratories of the University.

Final Meetings.

On Wednesday, July 10, came the General Plenary Meeting at which the resolutions of the various committees were formally approved, and cordial acknowledgment of the very generous hospitality received during the visit was made. Professor Charles Fabry was elected as the next President and Holland undertook to act as host in 1938, when the next meeting of the Commission will take place.

Next day saw the departure of delegates from Karlsruhe. The English delegation (numbering over sixty, the second largest contingent) left by different routes, some to return via Brussels in order to visit the Exhibition, others to recover from their labours in the quiet of the Black Forest.

A. R. M.

The Mechanism of Light Emission

A delightful lecture on the above subject was delivered by Professor Pohl (of Göttingen) in the Reichstag building at the opening meeting of the International Commission on Illumination. With only slight accessories and by the aid of quite simple experiments Professor Pohl gave an interesting analysis of the processes of light emission. He explained the ordinary thermal incandescence illustrated in incandescent lamps and in the candle flame, by showing its silhouette on a screen, the incandescent carbon particles show a dark shadow. The addition of H_2O_2 of a solution in the bottle gave rise to a green glow, illustrating the production of light by chemical means.

It was explained that with thermal incandescence, at 3,000° K only 9 per cent. of the energy falls within the limits of the visible spectrum, whilst at 6,000° K the maximum value of 40 per cent. is attained. This relatively high efficiency, however, is reduced to only 14 per cent. when the unequal sensitiveness of the eye for different wave-lengths is considered. Professor Pohl pointed out how this figure could be increased if the range of visible wave-lengths were extended, but he also showed, with the aid of the skull of a child, how physiological limitations would make this greater range of sensitiveness unattainable to human beings.

The final section of the lecture dealt with electric discharge gases and their use as illuminants. The application of phosphorescent substances to supply light and colours missing in the spectrum in such gases was illustrated. The influence of low temperatures, such as those associated with liquid air on phosphorescent effects, were shown by several effective demonstrations. A particularly pleasing experiment was that with a crystal of potassium bromide, showing the influence of ultra-violet radiation which excited the molecules of the crystal so that they become opaque to all visible light except the blue rays. Hence, when the U.V. radiation was applied, the colour of the transmitted light was changed from white to blue.

The lecture furnished a striking example of methods of conveying information by means of ingenious but simple demonstrations and experiments, and will long be remembered by those who had the pleasure of attending it.

Illuminating Engineering Society (U.S.A.)
29th Annual Convention

As we go to press we receive particulars of the above Convention which is to be held in Cincinnati during September 3-6. As usual a very comprehensive series of papers and reports, over thirty in number, has been arranged, and the device of parallel sessions is adopted. One innovation is an "open" meeting of council, arranged with the object of showing members how the business of the Society is transacted.

The Relation between Illumination and Industrial Efficiency

I.—The Effect of Size of Work

By H. C. WESTON

In what follows we give a summary of the above Report, which puts on record an extremely valuable investigation. Readers are recommended to study the complete Report, which is obtainable from His Majesty's Stationery Office.

Introduction.

THE present paper describes the first stage of an investigation which was set on foot to test the method suggested by Mr. A. W. Beuttell before the Illuminating Engineering Society for determining the degree of illumination required for the efficient carrying out of any kind of work.*

The method was based on the analysis of certain conditions, such as size, contrast, rate of movement, etc. So far only one variant has been examined, i.e., the relationship between *size* and illumination. As will be seen, the results enable one to determine the illumination necessary in order to ensure a given fraction of the optimum efficiency of work on objects of a given size.

Nature of Investigation.

The investigation was carried out at the National Physical Laboratory, where the performance of eighteen subjects, all males, from the staff of the Photometry Department was measured at six different illuminations, in each of which work at six different sizes was done. The work consisted in cancelling on specially prepared test sheets, of the type illustrated in Fig. 1, all the Landolt broken rings having a given gap-orientation. On six types of sheets the sizes of the circles were such that the eye of the gap subtended 1, 2, 3, 4, 6, and 10 minutes at the eye, when the latter was 13in. distant from the sheet. (In the original report the advantages of this special form of test are pointed out in detail.)

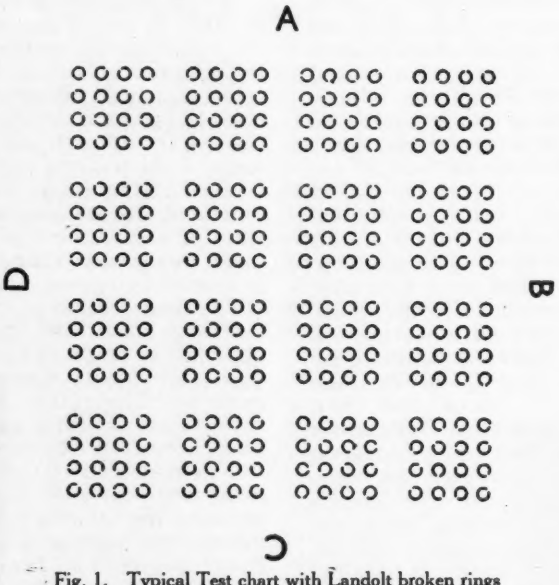


Fig. 1. Typical Test chart with Landolt broken rings of varying orientation.

Six cubicles were provided so that six subjects could work simultaneously, each at a different illumination. The illuminations in the respective cubicles were 0.16, 0.8, 4, 20, 100 and 500 foot-candles. Precautions were taken to avoid glare and also the formation of shadows on the test sheets. All subjects were tested for near vision and muscle balance, and it was found that each could read J.1 type with each at normal reading distance. Eleven of the subjects wore glasses.

Tests were made on Wednesday, Thursday, and Friday. Each group of six subjects attended for one morning and one afternoon session, though not on the same day. Thus thirty-six observations, two for each subject, were obtained for each size at each illumination. Only one minute was allowed for each test sheet, so that the working time for a complete set of sizes did not exceed six minutes, and thirty-six minutes was the working time for six sets, one at each value of illumination. The order of sequence of experiments was specially arranged with a view to avoiding passage from one extreme transitions in illumination in two successive periods.

The time available for each test sheet (one minute) was usually insufficient for the cancellation of the full number (forty-eight) of rings. The test was stopped and the time recorded as soon as one subject had completed the task. The number of rings correctly cancelled and also the number of rings overlooked was counted. The sum of these numbers gives the theoretically possible maximum performance, and the actual number of cancellations as a fraction of this maximum is a measure of accuracy. (It was found that the number of rings with a *wrong* gap-orientation which were cancelled was so small as to be negligible.) The actual number of rings cancelled in the allotted time was reduced to rings per minute and multiplied by the accuracy factor, giving a figure which takes into account both speed and accuracy. The "time per ring" includes both the "discrimination" and the "response" time. This response or action time was determined for each subject by means of modified test sheets in which the rings to be cancelled were clearly blocked out in red. If we subtract these values (which, as might be anticipated, vary little over the given range of illuminations) from the average gross time per ring, the reciprocal of the value thus obtained gives speed of discrimination. The ratio discrimination/action time is about 3 to 1 with the largest size of ring and the highest

* "Illuminating Engineer," January, 1934.

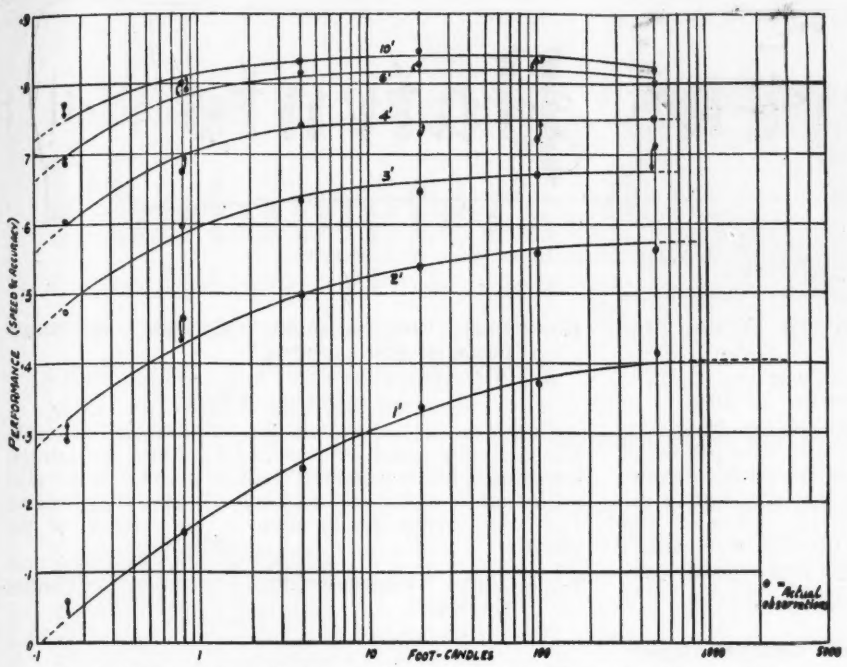


Fig. 2. Relation between Performance (Speed of Work) and Illumination (Foot-Candles.)

illumination, whilst under the worst conditions, i.e., the smallest size and lowest illumination, the ratio was about 15 to 1.

Results.

The graphs shown in Figs. 1 and 2 were derived from the actual average speeds determined, which are also set out in tabular form in the original report.

The effect of size on performance is greater at all illumination than is the effect of illumination at any size. Performance is directly proportional to the logarithm of the size, for sizes of one to four minutes; but for larger sizes the increment of performance diminishes, and it is relatively small when size is increased from six to ten minutes—even at low illuminations.

The relation between performance and illumination for all sizes is such that equal logarithmic increments of illumination are accompanied by increments of performance which progressively diminish in value. Above 2 foot-candles performance becomes practically independent of illumination with sizes larger than six minutes. Within the range of illuminations tried equal facility of vision is not possible for the largest and smallest size. Equal performance is not practicable and it is suggested that "equal percentage of maximum attainable performance at each size" should be substituted as the approved constant.

In Fig. 3 graphs based on values of performance corresponding to various percentages of the maximum attained, together with the corresponding values of illumination, are presented. The graphs tend to become more symmetrical as maximum performance is approached. When the size is large, and also when it is small, a change in size of a given ratio has a relatively smaller effect on the illumination required for maximum performance than does a change of similar ratio at intermediate sizes. The following series of values is presented as representing a range of intensities which are easily obtained in practice and which appear to ensure a close approximation to maximum performance:—

Size	10′	8′	6′	5′	4′	3′	2′	1′
Illumination (Foot-candles)	1.5	1.7	2.25	3.0	5.0	22.5	75	150

Conclusion.

In conclusion, it is remarked that it is *always* more difficult to see small objects than large ones. It is not possible to compensate this difference completely by an increase in illumination. It *is* possible, however, to reduce the difference, and by a sufficient illumination to secure conditions for maximum possible performance. Some judgment is needed in analysing a task to determine the size of detail which is studied with greatest frequency or is of greatest importance for ensuring accuracy of work. With practical tasks overall speed of performance is often determined to a greater extent by manipulative skill than speed of visual discrimination. In such cases the extent of the effect of illumination on facility of vision will not be adequately measured by the improvement in output observed—which may vary with different kinds of work even though each necessitates discrimination of detail of equal size. In an Appendix to the original paper a table and monogram, enabling the visual angle subtended at the eye by objects of varying size, for various distances between eye and object, is presented. (The type used in this article (10 point) subtends an angle of approximately 3 minutes at a distance of 13 inches).

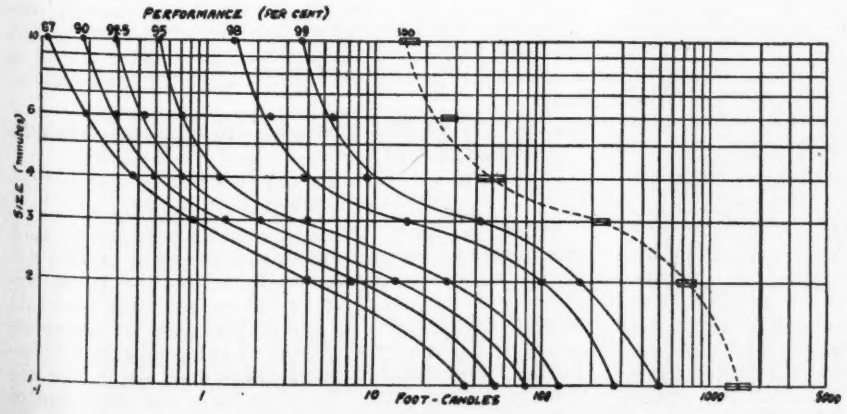


Fig. 3. Graphs showing Relation between Size and Illumination for 87%, 90%, 92·5%, 95%, 98%, 99% and 100% (estimated) Performance.

Recent Patents

(Abstracts of recent Patents on Illumination & Photometry.)

No. 429,357. "Improvements relating to the Projection of Light."

The Edison Swan Electric Company, Ltd., and Wheat, H. C., November 29, 1933.

This specification covers a projector for producing from a linear source a parallel beam. The projector comprises a stepped cylindrical lens and a reflector which directs forward or back to the light source all of the light which does not initially fall upon the lens. The reflector comprises a circular cylindrical portion of the same diameter as the lens with its axis at the source and a parabolic portion with its focus at the source.

No. 429,638. "Improvements in Hot Cathode Vapour Lamps."

Siemens Electric Lamps and Supplies Limited, and Aldington, J. N. February 7, 1934.

In order that the hot cathode may be located very near the end of the lamp envelope the envelope end is made of refractory material, or a screen of refractory material is disposed between the cathode and the end of the envelope.

No. 429,725. Improvements in or Relating to Photo-Sensitive Electric Discharge Devices and Circuit Arrangements Incorporating the Same."

Marconi's Wireless Telegraph Company Limited. September 19, 1933 (*Convention, U.S.A.*)

This specification describes a photo-electric ionization relay tube filled with gas at low pressure and having a thermionic cathode, an anode, and a photo-sensitive cathode. The potential difference between anode and thermionic cathode is maintained less than, and that between anode and photo-electric cathode greater than, the ionization potential. Activation of the photo-sensitive cathode causes ionization and sets up a relay action as between the thermionic cathode and anode. Particular constructions, operating characteristics and circuits are described.

No. 429,750. "Improvements in and Relating to Electric Lamps."

The British Thomson-Houston Company, Limited, Davies, L. J., Gibson, C., and Scott, W. J October 5, 1933.

This specification relates to lamps having a gaseous discharge tube operating with the arc discharge other than vertical and maintained axially of the tube magnetically by a core in proximity to the tube. The magnetic core is an integral part of the lantern or reflector of the lamp, other parts of which may be of non-magnetic material. A magnetising winding is provided upon the core part or elsewhere.

No. 429,762. "Improvements in Lighting Fittings."

Keene, J., and The Benjamin Electric, Limited, December 6, 1933.

This specification relates to lighting fittings employing gaseous discharge lamps providing a linear light source and applicable to street lighting. At least two directional reflectors are provided, focussed upon and directing light from different parts of the source. In an example a linear source and two reflectors are arranged in a hexagonal lantern, of which two opposite sides are wider than the remaining sides, and face up and down the street. Reference to Specification No. 426,069 is directed.

No. 429,961. "Improvements Relating to Incandescence Gas Lighting."

South Metropolitan Gas Company and Prestage, A. J. April 3, 1934.

This specification covers the combination of a substantially flat gas mantle with a flat flame gas burner, the mantle being mounted with its plane in or parallel with that in which the mixture of gas and air issuing from the burner would burn in the absence of the mantle.

No. 430,864. "Improvements in Illumination Control Devices."

Weston Electric Instrument Corporation, May 10, 1934 (*Convention, U.S.A.*).

This specification describes a control system for electric lamps, in which the lamp circuit is closed or interrupted by the moving part of a relay, which is connected with a photo-sensitive cell of the current generating type. One of the relay contacts may be magnetic to maintain the contacts closed, and a manual device may be provided for opening the contacts. Alternatively some other form of locking means may be provided. An arrangement for automatically switching on vehicle lamps is described.

No. 430,950. "Improvements in and Relating to Safety Lamps."

Chevlin, J. T. (*Communicated by Siemens Schuckertwerke Aktiengesellschaft*), *September* 14, 1934.

This case relates to safety lamps having a protective jacket or shade enclosing an explosion-preventing gas. The joint between the jacket or shade and the lamp body is sealed by a gasket, and the parts are so arranged that the pressure of the gas within the container increases the pressure on the gasket. The jointing surfaces and gasket may be tapered to obtain a wedging effect.

No. 431,212. "Improvements in Electric Incandescent Lamps."

The General Electric Company, Limited, and Dudding, B. P., March 2, 1934.

This specification describes a strip light lamp in which the filament is divided into a number of sections, of equal resistance, and thus adapted to be connected in parallel by tappings alternately connected to the external terminals of the lamp. A mathematical determination of the best number of sections for given conditions is given in the specification.

No. 431,252. "Improvements in Lighting Installations."

N. V. Philips Gloeilampenfabrieken, April 19, 1934 (*Convention, Germany*).

When a large number of transformers, each energising an incandescent cathode gas or vapour discharge tube, are connected in series, the tubes frequently do not light up or take some time to attain normal operation. To avoid this, some of the series connected primary windings of the energising transformers are shunted by a choke coil such that the voltage set up across its terminals, after ignition of tubes connected to transformers in series with the choke coil, is sufficient to ignite the tubes connected to the transformers in shunt with the choke coil.

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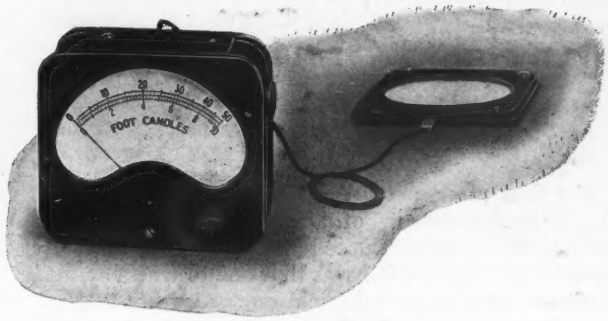
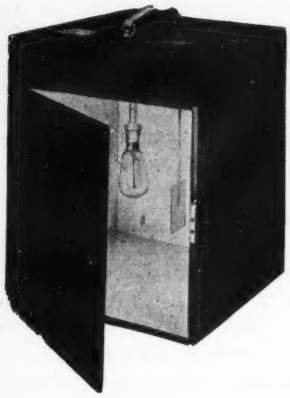
A complete range of Photometers employing the well-known Auto-photic cell is available for every kind of light measurement.



Hand Auto-photometer

AUTO-PHOTOMETERS embody the autophotic cell forming the test surface, together with a sensitive direct-reading illumination indicator of the moving-coil type, and can be used by anyone without previous experience, and are always ready for use. No battery, comparison lamp or other accessories are employed.

They are invaluable for demonstrating the level of illumination in large and small spaces, and will also be found extremely useful by manufacturers of electric lamps and fittings to demonstrate their efficiency. Minimum range 0—2·5 foot-candles.



Portable "Lumen-Cube" Photometer.

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STREET LIGHTING PHOTOMETER. — Measurement of illumination as low as 0.005 foot-candles (which is half the recognised minimum) is now possible with this remarkable instrument. True indications at large angles of incidence, accuracy with lights differing widely in colour and complete portability are other features which facilitate the rapid and reliable investigation of all lighting problems.

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Recent Improvements in Total Flux Photometers

(Communicated)

The first photometer for the determination, at a single measurement, of the total luminous flux emitted by a light source (whether expressed in lumens* or in M.S.C.P.) was that due to Ulbricht, and consisted of a large spherical enclosure finished internally with a dead white surface. Dr. Sumpner later showed that a cubical enclosure was equally accurate, provided that certain precautions were taken. There, however, the matter rested for many years, since at the time there was no call for a total flux photometer, lamps being still rated in directional candle-power, and the conception of luminous flux unfamiliar to the majority of illuminating engineers.

Under modern conditions of lighting it is recognised that the only logical basis upon which to compare one light source with another is the total emission of luminous flux, since it is this flux which is collected by a reflector or other fitting and redistributed in the required direction. The ratio of the flux sent out by the fitting to the total flux generated by the lamp in it represents the efficiency of the fitting. The integrating photometer serves to determine each of these quantities at a single measurement and has almost entirely superseded the photometer bench, except for certain special purposes.

The principle of operation of the Integrating Photometer is extremely simple, and is based upon the conception that so long as certain precautions are taken, the illumination on the walls of an enclosure is directly proportional to the total luminous flux emitted by a light source placed at or near the centre, irrespective of whether the angular distribution of the flux is uniform or not. Hence it is only necessary to measure the illumination at some given point in the walls of the enclosure by means of a suitable photometer in order to determine the total flux emitted by the light source. For this purpose the photo-electric photometer possesses so many advantages over the visual pattern, both on the score of precision and of rapidity and ease of working, that in what follows, its use is assumed. For similar reasons a cubical enclosure is described, although the methods dealt with are equally applicable to a spherical integrator. The integrating principle, simple as it is, involves a number of precautions and limitations if accurate results are to be obtained. In the first place, unless the light emission is perfectly uniform in all directions, it is essential that the rays of light from the source should not fall directly upon the photo-electric cell. If they do, an unsymmetrical course emitting, for example, most of its light in that direction would show a higher reading than another source with the same total output, but emitting most of its flux in some other direction. For this reason a shield is fitted, as seen at S in Fig. 1, between the light source L1 and the auto-photic cell.†

Again, the maximum permissible size of the light source is strictly limited, owing to the unknown quantity of light which it absorbs. It is obvious, referring to Fig. 1, that for a lamp of given output, the quantity of light reaching the autophotic cell will be less, the larger and/or the more opaque the lamp itself (or the fitting containing it) since as the light is reflected from wall to wall of the Cube it is intercepted, and some of it absorbed. This reasoning applies to all bodies situated inside the Cube, including, of course, the light source itself, together with any reflector or shade which may be in use. It is usual to calibrate the photometer before making a series of measurements by means of a sub-standard lamp of known luminous output, and if the absorption of the sub-standard is the same as that of the lamps to be tested no error is introduced. Since, however, this cannot usually be ensured, B.S.S. 354 (1929) for Photometric Integrators lays it down that the diameter of a spherical integrator (or the length of each side of a cubical integrator) should be not less than 4½ times the length of the largest lamp to be tested. When complete fittings are involved instead of bare lamps, no such simple rule is applicable and the question of limiting dimensions is quite indeterminate. For this reason some method has long been sought for determining whether or no the enclosure was large enough for its purpose.

A partial solution which can sometimes be used, consists in placing the lamp or fitting to be tested in the enclosure at the same time as the sub-standard lamp, the Cube being calibrated under these conditions. By this means, the absorption due to both lamps is to some extent operative during calibration and so might be expected to cancel out. There are, however, several objections to this method, apart from the fact that it is inconvenient to use, involving, as it does, two complete mounting systems and electrical connections for the lamps. A more serious objection is, however, that the sub-standard lamp and that under test are necessarily situated in different positions in the Cube (so that the path of the light emitted differs in each case), and that light from the sub-standard lamp shines directly upon the outside of the lamp or fitting under test, whereas it should only reach the latter after one or more reflections from the walls of the Cube. Besides all this, the method gives no clue as to whether the compensation is effective, nor as to the amount of such compensation which is being applied—whether large or negligibly small. For these reasons, the method is strictly limited in its application and is only applicable to the testing of small light sources of regular conformation.

Quite recently, Helwig has described* a method which obviates these difficulties and not only shows when a correction for light absorption is necessary, but enables the value of that correction to be at once determined. By this method, which is now embodied in the Everett-Edgcumbe Cube Photometers (see Fig. 2), lamps and fittings can be tested in enclosures which would hitherto have been regarded as impossibly small for the purpose.

The arrangement consists in fixing an auxiliary lamp inside the Cube as shown at L_2 in Fig. 1, and

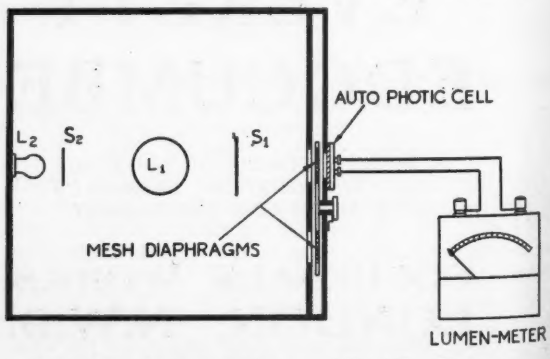

Fig. 1. Showing essential features of Total Flux Photometer.

* A source of 1 M.S.C.P. emits 4π (or,say, 12.5) lumens.

† The Everett-Edgcumbe rectifier pattern of photo-electric cell.

*"Das Licht," Volume 4, Page 115.

in determining the respective absorption of light from L_2, (a) by the sub-standard lamp, and (b) from the test lamp, by measuring the illumination produced at the autophotic cell when each lamp is in turn placed at L_1. The procedure in making a measurement is as follows:—

1. The sub-standard lamp is placed at L_1 and run at rated voltage, a reading being taken on the lumen meter. This reading is caused to correspond with the known luminous output of L_1 by means of the adjustable magnet shunt provided.
2. The sub-standard lamp (at L_1) is extinguished, but left in place, and L_2 is illuminated, a reading (R_1) being taken on the lumen meter.
3. L_2 is extinguished and the sub-standard lamp at L_1 replaced by that to be tested, a reading R_x being taken on the meter.
4. The test lamp at L_1 is extinguished but left in place, and L_2 run at the same voltage as before, a reading R_2 being taken on the meter.

If R_1 is found to be sensibly equal to R_2, it is evident that the absorption of the sub-standard and test lamps is equal, and no correction is necessary. If, on the other hand, R_1 differs from R_2, the true luminous output of the lamp under test is:—

$$\text{Lumens} = \frac{R_x \times R_1}{R_2}$$

$\frac{R_1}{R_2}$ —represents the correction for light absorbed by the two lamps, and a check is thus kept upon the value of the necessary correction.

As has been said, light would not, under working conditions, reach the outside of a lamp or fitting at L_1 until it had been reflected at least once from the walls of the enclosure and consequently, when carrying out this test, light from the auxiliary lamp L_2 should not fall directly upon the lamp or fitting at L_1. To ensure this an adjustable shield S_2 is provided between L_1 and L_2 of such a size and so placed as to shade the one from the other. In determining R_1 and R_2 it is unnecessary to know the luminous output of the auxiliary lamp (L_2), so long as it is maintained at a constant value—which may be ensured by carefully adjusting the terminal voltage whilst the readings R_1 and R_2 are being taken.

As regards the degree of accuracy to be expected from the integrator described, it may be said that it is found in practice that with a 28 in. Cube the luminous output of bare lamps up to 500 watts can be measured with an accuracy of some + 3 per cent., and even with large reflecting fittings up to 16 in. or 18 in. in diameter the errors should not exceed + 4 per cent. Without the use of the compensation method an 8 ft. or 10 ft. integrator would have been considered necessary for the testing of fittings of such dimensions.

Without the compensation method the accuracy of the result depends upon the assumption that the absorption of the sub-standard lamp and that under test are either negligible or are the same for both. It is of interest therefore to observe the value of the actual correction involved in a few typical cases. In a 28 in. integrator—which is a convenient size for general use—the correction with vacuum and gas-filled lamps of various sizes is found to range from zero to 12 per cent., according to wattage, pattern, age, etc. A reflector fitting measuring some 12 in. each way may give a correction factor of as much as 60 per cent. and a 6 in. opal globe fitting one of perhaps 25 per cent. An inspection of these figures shows how dangerous it is to assume that the readings obtained with even relatively large integrators are reliable, and how important it is to determine the value of the necessary correction in the way described so that it may be applied to the readings if necessary. It need hardly be added that where a series of similar lamps is to be tested, a single correction measurement will suffice for the whole series.

Fig. 2 shows the actual photometer (Everett-Edgcumbe) with autophotic cell and lumen indicator. It is normally provided with three or four ranges, a

Fig. 2. Everett-Edgcumbe Cube Photometer.

change from one to the other being made by means of a number of "mesh diaphragms" interposed between the cell and the interior of the Cube. These mesh diaphragms represent a very great advance on the neutral filter which is often used for the purpose, since the latter is not only liable to change its transmission constant with time but is never truly neutral in colour, so that inaccuracy is liable to be introduced from this cause also. It may be added that the Everett-Edgcumbe autophotic cell gives a practically linear response and is almost entirely free from temperature effects. The colour response of the cell very closely follows that of the normal human eye, and when the colour difference is excessive, as, for example, with mercury or sodium discharge lamps, a corrective filter is available.

From what has been said it will be evident that the highest rating of lamp which it is permissible to use in a given size of photometer is not so much a question of the relative dimensions of the lamp or its fitting, but rather of the dissipation of the heat developed by it. In order that a check may be kept upon this a thermometer is fitted above the autophotic cell, as will be seen in Fig. 2.

A Modified Architectural Lighting Unit

by T. C. ANGUS, A.M.I.E.E., and A. H. LATHAM.

(Department of Industrial Physiology, London School of Hygiene and Tropical Medicine.)

IN his recent paper, "Practical Considerations in Architectural Lighting,"* Mr. H. Lingard showed increases in the intensity of light emitted by laylights with the use of silvered glass reflectors. These increases, for laylights with internal finish of matt white, were of the order of 17 per cent. above that of the bare lamps, measured on the surface of the flashed glass. Mr. Lingard pointed out that the use of such reflectors is only justified when the price of electricity is fairly high.

Some results obtained by the Department of Industrial Physiology of the London School of Hygiene and Tropical Medicine, in a recent attempt to improve the efficiency of a typical built-in or architectural lighting unit, may be of interest because it was found that considerably increased illumination on the working plane could be obtained by the use of pieces of plane mirror of the cheapest description. It was also found that when a diffusing bowl was substituted for the ground glass of the laylight the height at which the bulb was placed in the fitting had a considerable influence on the total illumination, with little alteration to the relative distribution.

Fig. 1 shows that type of fitting investigated, in which a sheet of ground glass, 15 inches square, projects about 1¾ inches below the ceiling of the room, being held in a metal frame. Above the glass and imbedded in the ceiling of the room is a pyramidal enclosure with sides about 50 degrees to the horizontal. The sides of this enclosure were painted matt white and acted as a diffusing reflector. The source of light was originally a 150 watt "daylight" lamp.

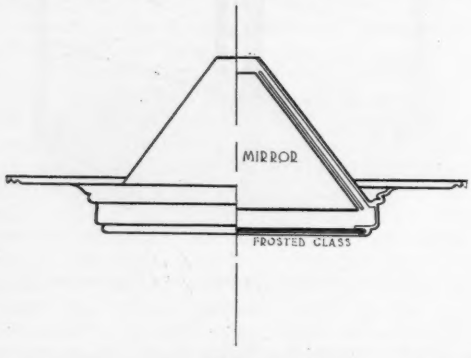

Fig. 1.

Curve (A) Fig. 2, shows the light intensity from one such unit as measured on a horizontal plane 7ft. 6in. below and along a central line parallel to the sides of the glass square. The maximum intensity is barely over 3 foot-candles.

Curve (B) shows the effect of substituting a clear bulb of the same wattage as the original "daylight" bulb.

The Effects of Plane Mirrors.

Curve (C) shows the distribution when four triangular pieces of common flat mirror were fixed inside the "pyramid"; the intensity rose by 210 per cent. directly underneath and by 100 per cent. at a point 5 feet to one side. A clear 150 watt lamp was used.

Diffusing Bowl.

Although the above modification resulted in a considerable improvement in efficiency obtainable at a small cost, it was thought that the light was still too concentrated and that a "patchy" illumination, with a dark ceiling would result.

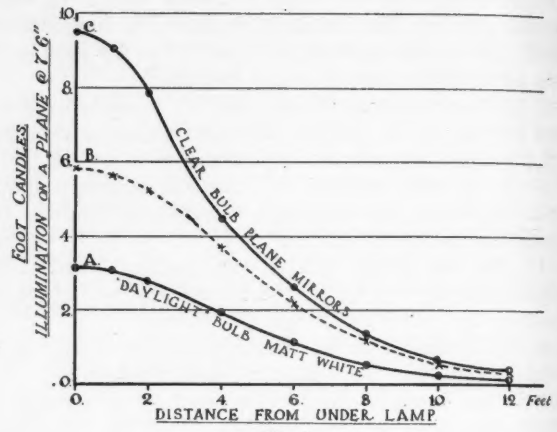

Fig. 2.

A 14-inch "Arethusa" bowl of milk glass (kindly supplied by the Engineering and Lighting Equipment Co., Ltd., of St. Albans) was therefore fitted to this lighting unit in place of the ground-glass screen.

In Fig. 3 the curves at (D) show the distribution of light from a unit so modified, with a 150 watt plain clear bulb within the white painted pyramid, while curves (E) show an increase over this value of 45 per cent. (at 5 feet) obtained by placing over the bulb a single sheet of plain mirror, pierced with a 2½ inch hole, through which the lamp was suspended.

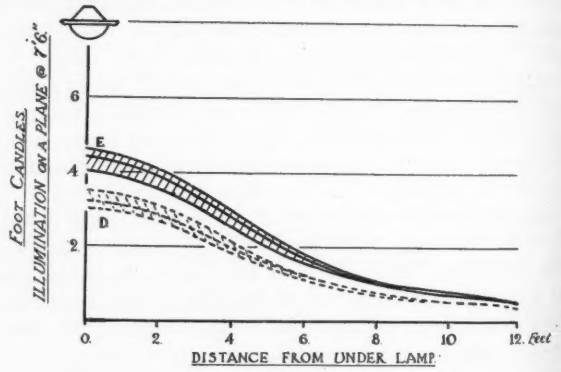

Fig. 3.

The six different curves represented in (D) and (E) show the differences obtained by altering the height of the bulb within the bowl; the highest values in every instance being obtained with the bulb in the lowest position, i.e., in contact with the inside of the bowl, the median values with the bulb raised one inch above the bowl and the lowest values with the bulb raised 2 inches above the bowl.

The price of converting a number of these fittings, with the four plain mirrors lining the "pyramid," would be about five shillings per fitting; the price of fitting the diffusing bowl and single mirror, ten shillings and eightpence.

The observations were made by means of a portable photometer of the selenium oxide type, duly corrected for instrumental errors and colour, but no allowance was made for reflection at the larger angles of incidence.

* Presented at a meeting of the Illuminating Engineering Society, April 9, 1935.

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Athletics by Artificial Light

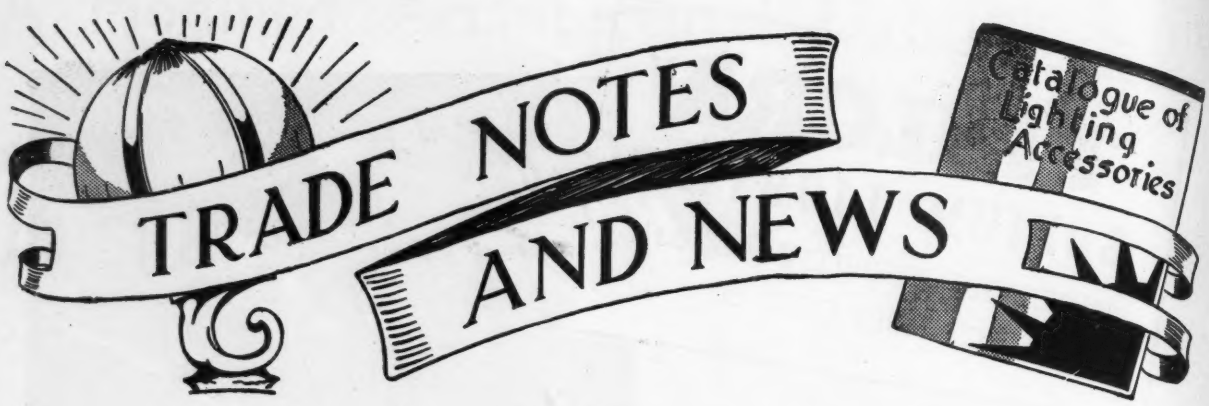
At the recent Dutch International Athletic Competition, it is stated, all the heats were decided by floodlight on the evenings preceding the finals, and similar methods have been adopted in America in the past. It seems likely that in this country athletic events will continue to be decided mainly by daylight. On the other hand several considerations that affect most other sporting events—the drawbacks of weather uncertainties (serious enough when competitions attended by athletes from different countries have to be postponed), the desire to continue practice and even competitions during the winter, and the continually extending programmes which threaten to outrun the time permissible—deserve serious consideration. The provision of suitable artificial lighting for athletics should be a much simpler problem than is presented by ball games, especially if events under cover are contemplated. It is interesting to observe that the holding of the next A.A.A. indoor championships at night has already been suggested. The playing of games—professional football, for instance—by artificial light has often been discussed and investigated. Floodlighted Rugby League football is now a familiar item. We are inclined to think, however, that the full benefit of artificial lighting for such spectacles will not be realised until the powers that be "go the whole hog" and arrange for such games to be played in a specially designed and illuminated arena under cover.

Reviews of Books

The Empire Municipal Directory and Year Book.

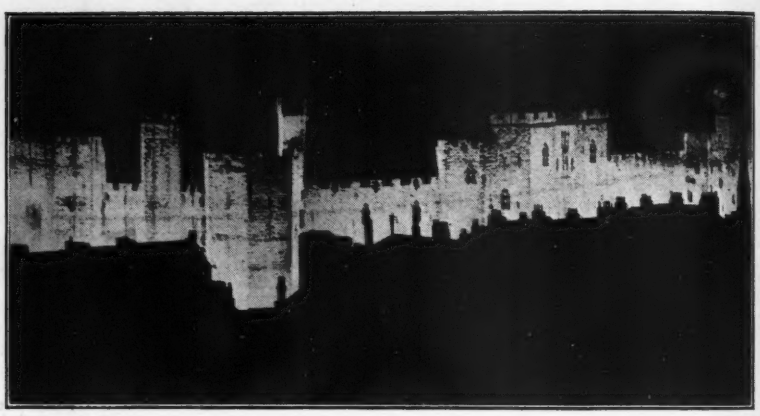
The Sanitary Publishing Co., Ltd. (*London*, 1935; *pp.* 328.)

On the eve of the Annual Conference of the Association of Public Lighting Engineers we take the opportunity to draw attention to the Empire Municipal Directory and Year Book, which contains a wealth of statistical information of value to public officers and authorities. In the present year the fifty-third edition has been reached. The volume contains over 300 pages of condensed information; these illustrate the continual expansion of the field with which municipal engineers and surveyors have now to deal. The book is at once a directory and a survey. The directory—we believe the only one of the kind issued—contains detailed lists of local authorities and their officials, both in the United Kingdom and in the Overseas Dominions. There are subsequently special sections dealing with such topics as Road Construction, Direction and Signal Signs, Public Lighting, Cleansing and Refuse Disposal, Fire Fighting and Prevention, Housing and Town Planning, Water Supply, etc. Useful features are the list of Statutes Passed and Departmental Orders issued during the past year, and the record of Examining Bodies, Government Departments, Congress and Conferences, and Universities and Institutions concerned with municipal engineering and public health. A final section entitled "Where to Buy" serves as a directory of firms concerned with the sanitary trades and of their product. Of special interest to our readers is the section on Public Lighting. This contains a section by Mr. W. J. Jones dealing with electric lighting, whilst Sir Francis Goodenough deals with the matter from the standpoint of the gas industry.



A Castle in the Air

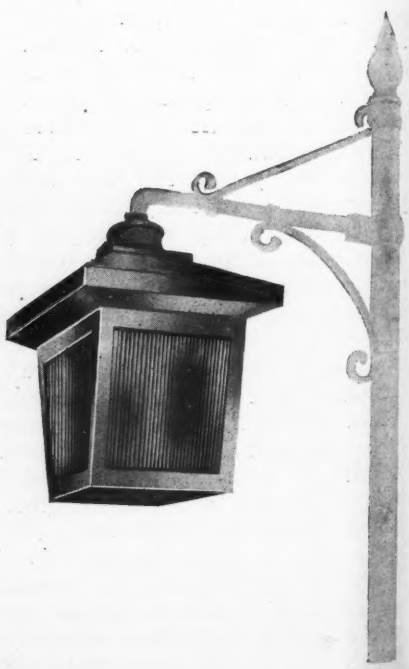
This description might well be applied to Caernarvon Castle—perhaps the finest historical monument in this country—which was floodlighted during the period of the Welsh National Eisteddfod. The lighting scheme was planned by the B.T.H. engineers in conjunction with Mr. A. C. Pike, Electrical Engineer, and Mr. Price F. White, Consulting Engineer to the Caernarvon Corporation. The units were concealed in the moat so as to be completely concealed from view, whilst the lighted Castle, in its commanding position, stood out in a most effective manner. A total distance of 690 ft., with a wall area of 25,800 sq. ft. was covered by the floodlighting, for which 63 Mazda Mercra electric discharge lamps were used.



Caernarvon Castle floodlighted.

Lanterns for Electric Discharge Lamps

The adjacent illustrations show new types of lanterns for mercury electric discharge lamps, carefully designed for efficient illumination of the roadway. These were shown at the B.I.F. by Simplex Electric Company Ltd. The company has also introduced a type of dustproof refractor lantern, which has recently been installed with success at Sutton Coldfield and on other important main roads.



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MORE LIGHT

without costing a penny more for lamps or current

MADE IN ENGLAND BY THE BRITISH THOMSON-HOUSTON CO., LTD.

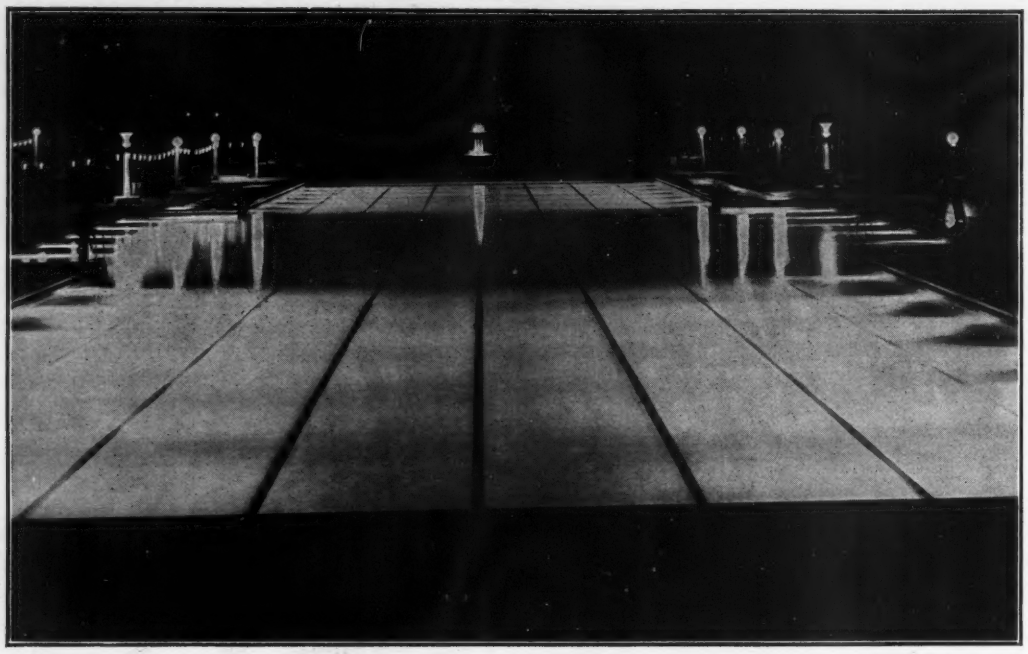


Fig. 1. A General View of the new Croydon Open Air Baths at night.

Lighting of the New Croydon Open Air Baths

(The first of its kind to be heated, illluminated and sterilised by means of electricity)

Fig. 2. Showing the Aerator Fountains equipped with colour-changing lighting.

The excellent night photographs reproduced in Figs. 1 and 2 give a good idea of the appearance by night of the new Croydon open-air baths (Purley Way), the first of their kind to be heated, illuminated and sterilised by means of electricity. The bath is 200 feet long and 70 feet wide on major axis, and 100 feet long by 60 feet wide on its minor axis, the central section (the deepest part) having a depth of 15 feet. A special feature is the under-water lighting by means of thirty-six chambers constructed in the walk round the bath. These are equipped with 1,000-watt Holophane under-water floodlighting projectors. Each unit is reached by means of a detachable slab which is flush with the concrete walk. The aerator fountains at the ends (see Fig. 2) are furnished with colour-changing lighting on the Holophane Auto-Control System. The continuous changes in colour of the illuminated fountains contrast with the colour-lighting in the base of the lily fittings shown on the side. A special ozone sterilising plant ensures the water being in perfect condition.

The pool was designed and the construction carried out by Mr. C. E. Boast, M.C., M.Inst., C.E., F.S.I., the Borough Engineer, and the electrical work was designed and supervised by Mr. F. N. Rendel Baker, A.M.I.E.E., Chief Engineer to the Corporation Electricity Department.

The "Queen Mary"

Much interest has been taken in the lighting equipment of this new Cunard White Star Liner. We are informed that the British Thomson-Houston Co., Ltd., have been given the contract for lighting of the majority of the First Class Public Rooms, Corridors, and Main Staircase. The General Electric Co., Ltd., are dealing with the lighting of the First Class Dining Saloon, Ballroom (including a colour-changing scheme), Smoke Room, Main Lounge, Standard Gallery and Long Gallery, etc. In both cases special fittings and equipment have been designed by the staffs of the companies. A contract has also been secured for lighting by Messrs. G.V.D. Illuminators, Ltd.

AN INVITATION

The announcement that G.V.D. Lighting has been specified for the new Cunarder,

Q.S.T.S. "QUEEN MARY"

lends special interest to the G.V.D. exhibit at the

SHIPPING, ENGINEERING & MACHINERY EXHIBITION—OLYMPIA—SEPT. 12-28.

You are cordially invited to call at

STAND No. 33 B

where a number of interesting applications of G.V.D. Patents will be demonstrated.

G.V.D.
ILLUMINATORS, LTD.,
Illuminating Engineers,
ALDWYCH HOUSE, ALDWYCH, W.C.2.
Phone: Holborn 7277.

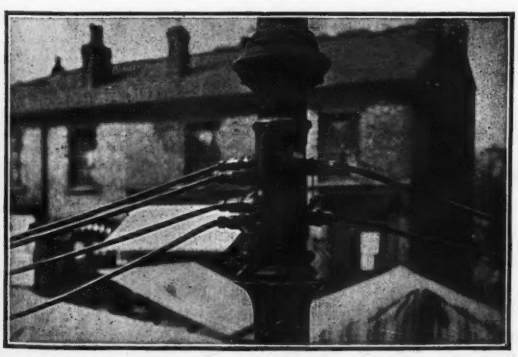
A Retiring Room at the Langham Hotel, W. One of the Laylights illuminated on the G.V.D. System. The dimensions are 4ft. x 3ft. and only two bulbs are used.

Cryselco Publicity

A very effective set of window showcards and other publicity literature has been prepared by Cryselco, Ltd. One device, featuring the coiled coil lamp, has the figure of a girl against deep shiny blue background, whilst the familiar figure of "Col. Cris Elco" appears in the foreground where the words "The Beauty of Good Light" are inscribed in gold. Another showcard shows the outlines of opal, clear, and pearl lamps, whilst below the "British Homes" for which they are intended are shown brilliantly illuminated. A third card relating to motor lamps shows the houses in what is evidently an old-world village brilliantly illuminated by the headlight as the car follows the turning road.

Lighting an Electric Lamp with a Match

At the Mazda stand of the Edison Swan Electric Co., Ltd., at Radiolympia this seemingly impossible feat was performed. The stand also contained equipment which, whilst primarily intended for the analysis of wave forms can also be applied to the gauging of the thickness of paper, the checking of labels on cans and the grading of products and materials by colour. We have also before us pictures of several recent Ediswan installations of interest. One of these shows the lighting, with Ediswan lamps and equipment, of the new factory of Thompson and Norris Manufacturing Co., Ltd., in the Great West Road. Another refers to the Escura electric discharge lamp, which is about to be installed for the lighting of the Southbury-road, Enfield.



This illustration of part of a "NIPHAN" market lighting installation shows main feeding sockets fitted to a lamp standard. The "NIPHAN" system is adaptable for every type of temporary or portable lighting installation, and designs will gladly be submitted.

MARKET LIGHTING with the NIPHAN System . . .

FOR some years we have been collaborating with public lighting authorities in devising temporary lighting installations for market stalls. The picture shows part of a "NIPHAN" market job, in which 6 sockets, in conjunction with a fuse board, were mounted on a lamp standard, with plugs leading to 3-way tees and suspended through-sockets.

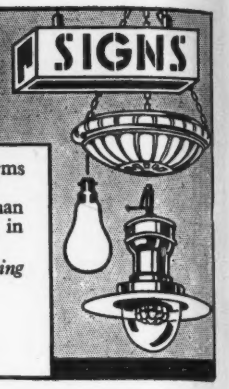
¶ *Our extensive market lighting experience is at your disposal.*

SIMMONDS & STOKES, LTD.,
4, Vernon Place, Southampton Row,
London, W.C.1.

NIPHAN

Tel.: Holborn 8637. 'Grams: "Niphon, London."

·WHERE TO BUY·
A DIRECTORY OF LIGHTING EQUIPMENT



We invite applications for spaces in this new section of the journal. Particulars of terms for each space (approx. 1 inch deep and 3¼ inches wide) are given below.

These terms are equivalent to **half our ordinary advertising rates,** but not less than 12 successive monthly insertions can be accepted on this basis, and amounts are payable in advance.

Payment for an advertisement in this section entitles the advertiser to receive *The Illuminating Engineer* during the period of the contract.

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1

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New Catalogue on application
Fittings manufactured to Architects' Specifications
ASCOG LIMITED
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2

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for testing candle-power and illumination. Benches, Cubes, Heads, Standards of Light, Special Fittings and Accessories.
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1, Westminster Palace Gardens, Artillery Row, Victoria St., London, S.W.1

3

ALLOM BROTHERS LTD.
16, GROSVENOR PLACE, LONDON, S.W.1.
Specialists in the Science of Modern Lighting, including :
Theatres and Public Halls. Tennis and Racquet Courts.
Pictures and Picture Galleries. Floodlighting, etc.
Decorative Fittings in Glass and Metal.

4

BENJAMIN
PLANNED LIGHTING
You get the benefit of over twenty years' experience in the science of Commercial & Industrial Illumination when you specify Benjamin.
THE BENJAMIN ELECTRIC, Ltd., TARIFF ROAD, N.17

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BROMFORD
Seamless Steel Lighting Standards
for all requirements
BROMFORD TUBE CO., LTD., ASTON, BIRMINGHAM

6

THE REINFORCED CONCRETE LAMP COLUMNS SPECIALISTS.
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WARE, Herts.

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DAWSON REFLECTORS
Indoor and Outdoor Floodlights
JENA REFLECTOR FITTINGS
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Telephone: Chancery 8801.

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ARCHITECTURAL ILLUMINATION AND DESIGNS
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Manchester, Glasgow, Hereford and Winchester.

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Sole Proprietors and Patentees of the **"ALL PURPOSES"**
TYPERLITE LOCAL LIGHTING UNITS
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BI-MULTI AND MULTIPLANE REFLECTORS
Lanterns, Brackets, Columns, Switch and Fuse Boxes, etc., FOR STREET LIGHTING
The Electric Street Lighting Apparatus Co.
The Foundry, Canterbury

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ELM WORKS, LTD.
Established 1903 Summerstown, London S.W.17
Suspension Lamps, Lanterns, **REFLECTORS** for **PUBLIC & INDUSTRIAL LIGHTING**
GAS and ELECTRIC
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12

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For Domestic and Artistic Lighting Fittings
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Cast Iron Columns *Street Lanterns*
Fuses ELEC CO LTD *Winches*
Time-Switches *Contact Gears*
ENGINEERING & LIGHTING EQUIPMENT COMPANY LTD., ST. ALBANS, HERTS.

14

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employing light sensitive
PHOTO-ELECTRIC CELLS
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15

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All kinds of Lamps, Reflectors, etc., Tested
LAMPS TESTED TO B.S.S. No. 161, 1934
SCALE OF FEES ON APPLICATION TO THE SUPERINTENDENT
66, SOUTHAMPTON ROW, W.C.1

16

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L. G. Rawlins & Co. Ltd. 30-35 Drury Lane, LONDON, W.C.2

FLOODLIGHTING & FITTINGS LTD.
294, GRAY'S INN ROAD, W.C.1
Manufacturers of "FLOOD" Units
Specialists in Modern Lighting Fittings
Telephone: TERMINUS 5954.

500/1000 Watts
Model "B"

FOSTER & PULLEN Ltd.
make all types of Lanterns for Street Lighting BY GAS
Samples for trial willingly sent—we invite comparison on both cost and quality
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MINISTRY OF TRANSPORT ILLUMINATED ROAD SIGNS AND GUARDIAN ANGEL GUARD POSTS LAMP COLUMNS, ETC.
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PIONEERS of AUTOMATIC LIGHTING
GAS CONTROLLERS, ELECTRIC, and SYNCHRONOUS TIME SWITCHES
Manufactured by:—
BRITISH, FOREIGN AND COLONIAL AUTOMATIC LIGHT CONTROLLING CO., LTD., BOURNEMOUTH.

CONTROLLED LIGHT
Laylights, Cornice and Pillar Lighting. **G.V.D.** *Pendant Fittings and Standards.*
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BRITISH MADE ILLUMINATING GLASSWARE AND FITTINGS, TRAFFIC GLOBES AND SIGNS, ISLAND COLUMNS AND FOOTLIGHTS.
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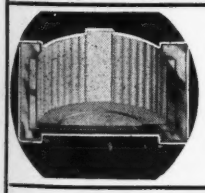
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Specify
HOLOPHANE
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ELVERTON ST., LONDON, S.W.
for
STREET CHURCH INDUSTRIAL
CINEMA FLOOD SCHOOL, Etc.

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EQUIPMENT *for* INDUSTRIAL, COMMERCIAL, STREET AND RAILWAY LIGHTING, FILM STUDIOS, PHOTOGRAPHY, PRINTING, ETC., —SUPERIOR QUALITY AND DESIGN—

UP TO DATE
Street Lighting Equipment
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LINOLITE (Regd.)
THE ARCHITECTURAL STRIP.

Longest Electric Firm Glasgow
Winches, Lamp Lowering and Suspension Gear, Searchlights *(largest and smallest in the world)*, Mirrors, Lenses, Carbons, Floodlights, Flexible Couplings (all-metal), Wire Ropes, Headlights,

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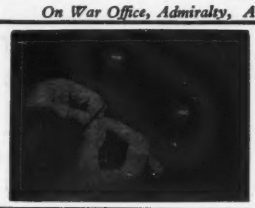
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FOR CLOSE-UP LIGHTING
ADJUSTABLE FITTINGS FOR EVERY USE.
MEK-ELEK ENGINEERING LTD., 16, Douglas Street, LONDON, S.W.1

Floor Standards, Ceiling Pendants, Wall and Corner Brackets
MONOLAMP
Modern Indirect Fittings
308, REGENT ST., W.1
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Silver Glass Reflectors and Metal Spinnings
TELEPHONE: LANG. 2817. *GOLD MEDAL—PARIS, 1931.*

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PROMOTERS OF SCIENTIFIC STREET LIGHTING BY GAS
Our Research Lighting Bureau will solve your problems
IRON LANE·STECHFORD·BIRMINGHAM
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RADIOVISOR PARENT LTD.
28, LITTLE RUSSELL STREET, LONDON, W.C.1
Specialists in Light Actuated Apparatus
AUTOMATIC CONTROL of STREET and FACTORY LIGHTING
No maintenance costs—Applicable to both A.C. and D.C. Supplies
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38-39, UPPER THAMES STREET, LONDON, E.C.4
ELECTRIC LAMPS of all types. ELECTRIC LIGHT FITTINGS. FLOODLIGHTING APPARATUS. SHOP-WINDOW LIGHTING EQUIPMENT. STORE LIGHTING. INDUSTRIAL LIGHTING. CINEMA LIGHTING, ELECTRIC SIGNS, Etc.

NIPHAN
PLUGS, SOCKETS, TEES, COUPLINGS, TERMINAL SOCKETS AND JOINT BOXES *for every portable and temporary lighting requirement.*
SIMMONDS & STOKES, LTD.
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PHOTO-ELECTRIC CELLS
Selenium Layer Type (Brit. Pat.) round or square, for all kinds of light-sensitive apparata.
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ARMOUR HOUSE, ST. MARTIN'S-LE-GRAND, LONDON, E.C.1
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STRAIGHT-LITE REFLECTORS, LTD.,
73, CANONBURY ROAD, LONDON, N.1.
ALL OUR FITTINGS CAN BE WIRED READY FOR ALTERNATE SWITCHING AND SUPPLIED ANODISED FINISH IN ALL COLOURS, CHROMIUM PLATE OR COLOUR SPRAY.
Write for Details. *'Phone: Canonbury 2066.*

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Specialists in Modern Theatrical Lighting
Manufacturers of "Sunray" Lighting Equipment
Electrical Installation Contractors. Lighting Schemes for
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Shop Windows Dress Parades Ballrooms Tea Lounges

WARDLE ENGINEERING Co., Ltd.
OLD TRAFFORD, MANCHESTER
STREET LIGHTING EQUIPMENT. TRAFFIC SIGNALS
PRISMAT BULKHEAD FITTINGS. FLOODLIGHT PROJECTORS
WORKSLITE REFLECTORS. WARDELYTE GLASSWARE

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For every type of GAS LIGHTING
SUGG WESTMINSTER
When you want the best!
CHAPTER ST. S.W.1

"PHOTRONIC" Photo-electric ILLUMINATION METERS
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"THE FITTINGS THAT IMPROVE WITH AGE"
WOODFYT
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Catalogue sent on application

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Contracts Closed

THE BRITISH THOMSON-HOUSTON CO., LTD.

H.M. Office of Works—For the supply of Mazda lamps during the nine months ending April 30, 1936.

City and County of Newcastle-on-Tyne—For the part supply of Mazda regular lamps and also bus lamps.

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H.M. Office of Works—For the supply of Siemer vacuum and gasfilled lamps for a period of nir months ending April 30, 1936.

We are informed that the Cambridge Town Coun have decided on gas lighting for the next ten yea the area affected includes the principal routes in t central part of the borough, the lighting bill bei over £2,000 per annum.

SIMPLEX
Industrial, Commercial & Street Lighting Shopwindow

REFLECTOR FITTINGS
SCIENTIFICALLY DESIGNED
SIMPLEX ELECTRIC CO., LTD.
Head Office: 159, GREAT CHARLES STREET, BIRMINGHAM, 3

"LUX"
(La Revue de l'Eclairage)

WE have pleasure in announcing to our readers that we have entered into an arrangement to receive subscriptions for the French Journal "Lux" (La Revue de l'Eclairage). The subscription per annum is 30 francs, the approximate equivalent of which in English money is Seven Shillings and Six Pence (7/6).

"Lux" is the only French journal which specialises in all aspects of lighting; it is the official organ of the Association Francaise des Ingenieurs de l'Eclairage (equivalent to the Illuminating Engineering Society in France).

It furnishes a complete record of interesting developments in lighting in France and on the Continent. It is fully illustrated and in particular devotes a considerable number of its pages to Decorative Lighting.

By studying these articles and the numerous photographic reproductions of modern lighting installations the reader can readily gain an excellent impression of French methods and practice in matters of Illumination.

Applications for subscriptions will be received by "The Illuminating Engineer," 32, Victoria Street, London, S.W.1.

UP-TO-DATE WITH GAS

Corporation Street, Birmingham, under the new system of Gas Lighting.

New Street, Birmingham, under the new system of Gas Lighting.

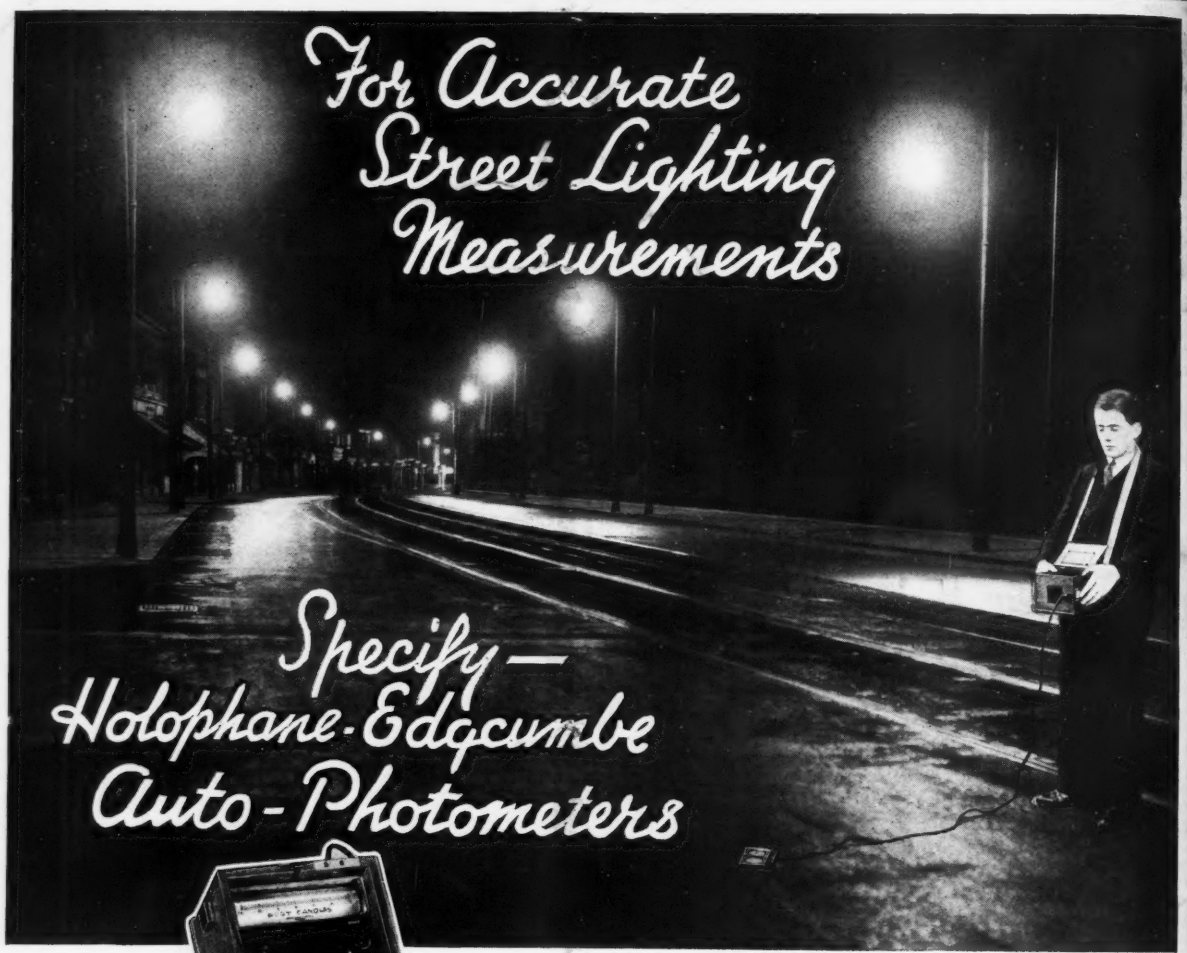
means A1 light for Birmingham

When Birmingham resolved to provide conditions of illumination corresponding to "class A" of the British Standard Specification they chose high pressure gas lamps suspended over the carriageway by wire cables spanning the street and attached to buildings on each side.

The respective widths of the carriageways in New Street and Corporation Street are 35 ft. and 40 ft. Pairs of lamps, each yielding about 3,000 c.p., are mounted 7 ft. apart, and spaced at intervals of 70 ft. The height of the lamps above the surface of the roadway is 26 ft. 6 in.

Please write for a copy of our street lighting booklet "To every public man and woman" — it's free — to the address below.

THE BRITISH COMMERCIAL GAS ASSOCIATION, *28, Grosvenor Gardens, London, S.W.1.*



MODEL "A"

HOLOPHANE-EDGECUMBE
AUTO-PHOTOMETER
MODEL **A**

IS THE IDEAL INSTRUMENT FOR ALL STREET LIGHTING ILLUMINATION TESTS

The **LIGHT SENSITIVE SURFACE** comprises Two Large Size Holophane-Edgcumbe Autophotic Cells, which are extremely sensitive and give accurate indications even when the light is incident on them at wide angles—up to 70°.

THE INDICATOR is a robust moving-coil galvanometer, specially constructed to withstand rough usage.

RANGES.—Normally three or four ranges are provided, the full scale readings being 0.3—3—30 foot-candles in the three-range instrument, and the same with 150 foot-candles in the four-range instrument.

DISCHARGE LAMPS.

In order to allow for the difference in colour values between the light given by various types of lamps which are used for Street Lighting purposes **AUTOMATIC CORRECTION** is provided **WITHIN THE INSTRUMENT.** By turning a switch on the instrument panel to correspond to the type of light source in use it is possible to take direct readings of Metal Filament Electric Lamps, Incandescent Gas Mantles, Mercury and Sodium Discharge Lamps.

A FULL RANGE OF AUTO-PHOTOMETERS IS AVAILABLE FOR GENERAL LIGHTING REQUIREMENTS.

WRITE FOR NEW LISTS GIVING FULL DETAILS TO—

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